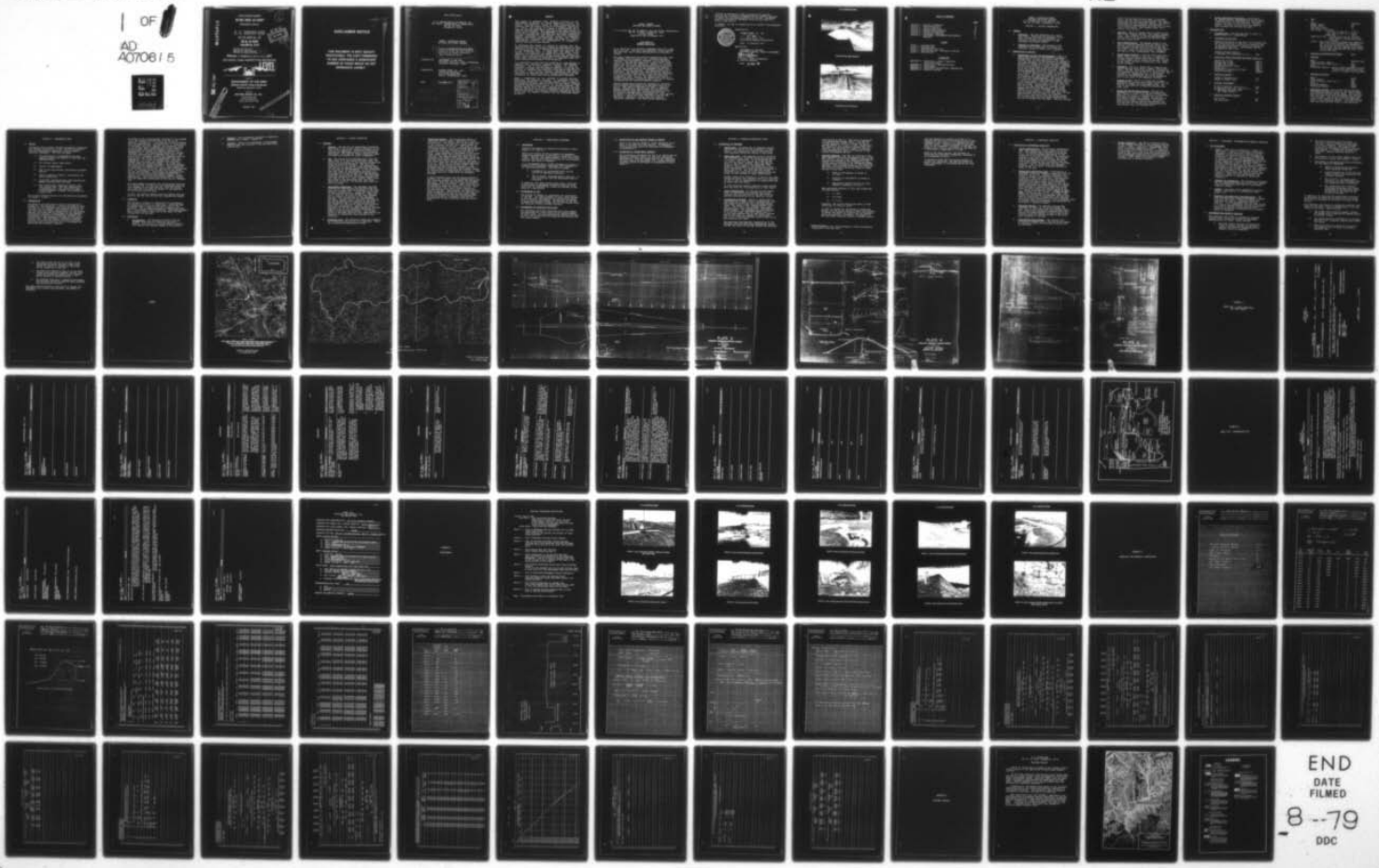
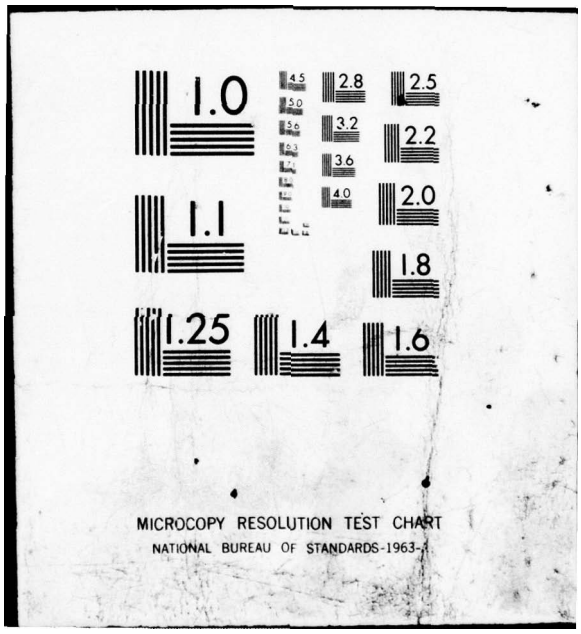
AD-A070 615 BAKER (MICHAEL) JR INC BEAVER PA F/G 13/2
NATIONAL DAM SAFETY PROGRAM. H. B. NORTON DAM PA NO NAME NO. 42--ETC(U)
FEB 79 C Y CHEN DACW31-79-C-0011
NL

UNCLASSIFIED

1 OF 1
AD A070615



END
DATE FILMED
8-79
DDC


1.0
1.1
1.25
1.4
1.6
1.8
2.0
2.2
2.5
2.8
3.2
3.6
4.0
4.5
5.0
5.6
MICROCOPY RESOLUTION TEST CHART
NATIONAL BUREAU OF STANDARDS-1963-A

OHIO RIVER BASIN

BIG MILL CREEK, ELK COUNTY

PENNSYLVANIA

H. B. NORTON DAM

(PA NO NAME No. 42)

NDI No. PA 00385

PennDER No. 24-35

PHASE I INSPECTION REPORT

NATIONAL DAM INSPECTION PROGRAM

LEVEL II

prepared for

DEPARTMENT OF THE ARMY

Baltimore District, Corps of Engineers

Baltimore, Maryland 21203

prepared by

MICHAEL BAKER, JR., INC.

Consulting Engineers
4301 Dutch Ridge Road
Beaver, Pennsylvania 15009

February 1979

DISCLAIMER NOTICE

THIS DOCUMENT IS BEST QUALITY PRACTICABLE. THE COPY FURNISHED TO DDC CONTAINED A SIGNIFICANT NUMBER OF PAGES WHICH DO NOT REPRODUCE LEGIBLY.

OHIO RIVER BASIN

H. B. NORTON DAM (PA NO NAME NO. 42)
ELK COUNTY, COMMONWEALTH OF PENNSYLVANIA
NDI NO. PA 00385
PennDER NO. 24-35

PHASE I INSPECTION REPORT
NATIONAL DAM SAFETY PROGRAM

(6) National Dam Safety Program. H. B. Norton Dam (PA No Name No. 42)(NDI-PA-00385, PennDer No. 24-35), Ohio River Basin, Big Mill Creek, Elk County, Pennsylvania. Phase I Inspection Report.

Prepared for: DEPARTMENT OF THE ARMY
Baltimore District, Corps of Engineers
Baltimore, Maryland 21203

(12) 94p.

Prepared by: MICHAEL BAKER, JR., INC.
Consulting Engineers
4301 Dutch Ridge Road
Beaver, Pennsylvania 15009

Date: (11) February 1979

(15) DACW31-79-C-0011

(10) C. Y. Chen

Accession For	
NTIS GRA&I	☑
DDC TAB	☐
Unannounced	☐
Justification	
By	
Distribution/	
Availability Codes	
Dist.	Avail and/or special
A	23

410 795

PREFACE

This report is prepared under guidance contained in the "Recommended Guidelines for Safety Inspection of Dams," for Phase I Investigations. Copies of these guidelines may be obtained from the Office of Chief of Engineers, Washington, D.C. 20314. The purpose of a Phase I Investigation is to identify expeditiously those dams which may pose hazards to human life or property. The assessment of the general condition of the dam is based upon available data and visual inspections. Detailed investigation, and analyses involving topographic mapping, subsurface investigations, testing, and detailed computational evaluations are beyond the scope of a Phase I Investigation; however, the investigation is intended to identify any need for such studies.

In reviewing this report, it should be realized that the reported condition of the dam is based on observations of field conditions at the time of inspection along with data available to the inspection team. In cases where the reservoir was lowered or drained prior to inspection, such action, while improving the stability and safety of the dam, removes the normal load on the structure and may obscure certain conditions which might otherwise be detectable if inspected under the normal operating environment of the structure.

It is important to note that the condition of a dam depends on numerous and constantly changing internal and external conditions, and is evolutionary in nature. It would be incorrect to assume that the present condition of the dam will continue to represent the condition of the dam at some point in the future. Only through frequent inspections can unsafe conditions be detected and only through continued care and maintenance can these conditions be prevented or corrected.

Phase I Inspections are not intended to provide detailed hydrologic and hydraulic analyses. In accordance with the established guidelines, the spillway design flood is based on the estimated "Probable Maximum Flood" for the region (greatest reasonably possible storm runoff), or fractions thereof. The spillway design flood provides a measure of relative spillway capacity and serves as an aid in determining the need for more detailed hydrologic and hydraulic studies, considering the size of the dam, its general condition and the downstream damage potential.

PHASE I REPORT
NATIONAL DAM SAFETY PROGRAM

H. B. Norton Dam (Pa. No Name No. 42), Elk County, Pennsylvania
NDI No. PA 00385, PennDER No. 24-35
Big Mill Creek
Inspected 13 and 14 November 1978

ASSESSMENT OF GENERAL CONDITIONS

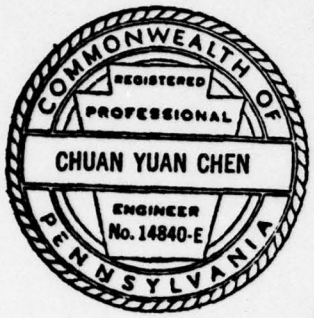
H. B. Norton Dam is an earthfill embankment dam with a sheet steel core wall. The dam is approximately 37 feet high and 900 feet long, and is owned and operated by the Borough of Ridgway.

The visual inspections and review of engineering data, made in November 1978 and January 1979, indicated some deficiencies requiring remedial treatment, but not emergency attention. The dam was found to be in good overall condition at the time of the inspection. However, it is recommended that the spalled and deteriorated concrete spillway wing walls, sills and transition buttresses be repaired. The bare and eroded areas of the embankment should also be properly graded and replanted. The grass should be well maintained. The seepage areas found during the inspection were not considered detrimental to the structural stability of the dam at this time, nor were there any structural inadequacies noted. However, the seepage areas should be further investigated to determine their cause and to develop recommendations for necessary remedial measures.

Hydraulic/hydrologic evaluations, performed in accordance with procedures established by the Baltimore District of the U.S. Army Corps of Engineers for Phase I Inspection Reports, revealed that the spillways will not pass the Probable Maximum Flood (PMF) without overtopping the dam. The analysis indicated that the spillways will pass 33 percent of the PMF before overtopping will occur and that the dam will likely fail under less than 50 percent PMF conditions. Therefore, the spillways are rated as "seriously inadequate." The owner should immediately

initiate an engineering study to evaluate the spillway capacity and to develop recommendations for remedial measures to reduce the overtopping potential of the dam. Procedures should be provided for emergency action in the event of a flood or dam failure.

In summary, the dam is categorized as an "unsafe"-"non-emergency" condition.



Submitted by:

MICHAEL BAKER, JR., INC.

C. Y. Chen

C. Y. Chen, Ph.D., P.E.
Engineering Manager-Geotechnical

Date: 16 February 1979

Approved by:

DEPARTMENT OF THE ARMY
BALTIMORE DISTRICT, CORPS OF ENGINEERS

J. K. Withers

J. K. Withers
Colonel, Corps of Engineers
District Engineer

Date: 15 Mar 79

Overall View from Right Abutment

Overall View from Left Abutment

TABLE OF CONTENTS

PLATES

APPENDICES

PHASE I INSPECTION REPORT
NATIONAL DAM SAFETY PROGRAM
H. B. NORTON DAM (PA NO NAME NO. 42)
NDI No. PA 00385, PennDER No. 24-35

SECTION 1 - PROJECT INFORMATION

1.1 GENERAL

a. Authority - The Dam Inspection Act, Public Law 92-367, authorized the Secretary of the Army, through the Corps of Engineers, to initiate a program of inspection of dams throughout the United States.

b. Purpose of Inspection - The purpose of the inspection is to determine if the dam constitutes a hazard to human life or property.

1.2 DESCRIPTION OF PROJECT

ABSTRACT

a. Description of Dam and Appurtenances - The H. B. Norton Dam consists of an earthfill embankment approximately 37 feet high and 675 feet long. A 75-foot wide, concrete ogee spillway is located at the right abutment, and a 150-foot wide emergency spillway is located at the left abutment. Seepage control is provided by a steel core wall comprised of 72-inch by 96-inch by 1/4-inch steel sheets, which are riveted and welded in place. The downstream embankment rises at a slope of 2 horizontal to 1 vertical (2H:1V) to the crest at elevation 1422.4 feet. The upstream slopes rise at 2.5H:1V to elevation 1412 feet and then 2H:1V to the 12-foot wide crest ~~(see Plate 4)~~. The upstream face is lined with well-placed sandstone riprap, typically 1- to 2-foot square. The ogee type spillway has a crest elevation of 1415 feet, or 7 feet lower than the top of dam. Approximately 225 feet to the left of the ogee spillway is a concrete screen chamber built into the embankment. The intake consists of two pipes, a 16-inch cast-iron pipe with an invert elevation of 1400 feet and a 36-inch cast-iron pipe with an invert at elevation 1386.0 feet. The outlet from the screen chamber is a 36-inch cast-iron pipe which separates near the toe of the dam into two pipes. One is a 16-inch

ABSTRACT

cast-iron line that delivers water to the pump house, and the other is a 36-inch cast-iron pipe which exits to the downstream channel. The channel downstream from the principal ogee spillway is rock-lined for approximately 230 feet with a 5-foot wall on both sides. This channel exits into a natural stilling pool.

b. Location - The H. B. Norton Dam is located on Big Mill Creek, Ridgway Township, Elk County, Pennsylvania. The structure is located approximately 1.1 miles north of the confluence of Big Mill Creek and the Clarion River.

c. Size Classification - The maximum height of the dam is 37 feet as measured from the invert of the 36-inch blow-off pipe and the crest of the dam. The reservoir volume to the top of the dam, elevation 1421.9 feet, is 1253 acre-feet. Therefore, the dam is in the "Intermediate" size category.

d. Hazard Classification - Loss of life would likely result from a failure of the dam. In addition, serious economic impact could result from the loss of water supply due to failure of the dam. Based on the above, the dam is classified in the "High" hazard category.

e. Ownership - The H. B. Norton Dam is owned by the Ridgway Borough Water Works, Ridgway, Pennsylvania 15853. The dam, previously known as PA No Name No. 42, was dedicated in 1961 as the H. B. Norton Dam. The dedication is commemorated by a brass plaque mounted on the downstream side of the embankment just to the right of the emergency spillway.

f. Purpose of Dam - The H. B. Norton Dam (Ridgway Reservoir) is the sole water supply source for the Borough of Ridgway and surrounding areas. The lake is also used for fishing and non-motorized water craft.

g. Design and Construction History - The dam was designed by H. B. Norton of the Elk Tanning Company, and N. W. Rood. Construction of the present structure was begun on 6 October 1931 by the Williamson Construction Company, 223 Monroeville Road, Turtle Creek, Pennsylvania. The Donora Construction Company, Donora, Pennsylvania took over the work on 9 August 1932 and completed the contractural work on 2 November 1932.

h. Normal Operational Procedures - According to Mr. Richard Herzog, superintendent of the water treatment plant, no procedures are instituted to control the level of the reservoir. He does, however, maintain a daily log of the depth of water flowing over the ogee spillway.

1.3 PERTINENT DATA

a. Drainage Area - The drainage area of the H. B. Norton Dam is 30.1 square miles.

b. Discharge at Dam Site -

Maximum Known Flood at Dam Site - On 17 March 1936 the flood crested at 5 feet 4-1/2 inches of head on the main spillway and 2 feet 4-1/2 inches on the emergency spillway. The maximum flow was estimated at 5400 c.f.s.

Ungated Spillway Capacity at Maximum Pool Elevation (c.f.s.) -	9100

c. Elevation [feet above Mean Sea Level (M.S.L.)] -

Design Top of Dam -	1422.0
Minimum Top of Dam -	1421.9
Average Top of Dam -	1422.4
Emergency Spillway Crest -	1418.0
Normal Pool -	1415.0
Streambed at Centerline of Dam -	1385.0
Maximum Tailwater -	Unknown

d. Reservoir (miles) -

Length of Maximum Pool -	1.6
Length of Normal Pool -	1.3

e. Storage (acre-feet) -

At Top of Dam (El. 1421.9 ft.) -	1253
At Spillway Crest (El. 1415.0 ft.) -	617
At Emergency Spillway Crest (El. 1418.0 feet) -	866

f. Reservoir Surface (acres) -

Top of Dam -	108
Spillway Crest -	76

g. Dam -

Type -	Earthfill
Length (feet) -	900
Height (feet) -	37
Top Width (feet) -	12
Side Slopes - Upstream - (In situ to 1412 ft.) -	2.5H:1V
(El. 1412 to 1422 ft.)-	2H:1V
Downstream -	2H:1V
Impervious Core - 72-inch by 96-inch by steel sheets, riveted and welded in place.	1/4-inch

Cutoff - The steel core wall extends into underlying, stiff, blue clay beneath the embankment. The 4-foot by 4-foot concrete cutoff below the principal spillway extends into bedrock on the right side and into the stiff, blue clay on the left.

h. Diversion and Regulating Tunnel - None

i. Spillway -

Type -	Concrete ogee
Length of Weir (feet) -	75
Crest Elevation (feet M.S.L.) -	1415
Gates -	None
Downstream Channel - Neatly placed sandstone boulders, 75-foot wide and 230-foot long, exits to a natural stilling basin.	

j. Emergency Spillway -

Type -	Earth
Width (feet) -	150
Crest Elevation (feet M.S.L.) -	1418
Gates -	None
Upstream Channel -	Earth
Downstream Channel -	Earth

k. Regulating Outlets - One 16-inch and one 36-inch cast-iron pipe provide inlets to the screen chamber with manually operated sluice gates. One 36-inch cast-iron pipe exits from the chamber and separates into two pipes. One 36-inch cast-iron pipe, with a gate valve located at the toe of the embankment, exits to the downstream channel. The other 16-inch cast-iron pipe delivers water to the pump house.

SECTION 2 - ENGINEERING DATA

2.1 DESIGN

The design data reviewed included information concerning the original construction in 1931 and 1932 [available from the Pennsylvania Department of Environmental Resources (PennDER)]. The file included:

1) Pre-construction correspondence and subsequent requests for permits to draw down the impounded water.

2) The original permit application.

3) Various correspondence.

4) Some of the semi-monthly construction progress reports.

5) Various inspection reports, both during and after construction.

6) Information concerning high water periods and damage resulting from the water.

7) Post-construction inspection reports from 1933 through 1948. The last inspection by a representative of the Division of Dams and Encroachments, PennDER, was performed on 1 April 1965.

The original design drawings are reproduced and presented as Plates 3, 4 and 5.

2.2 CONSTRUCTION

According to the application filed by the Borough of Ridgway for the dam permit, a serious shortage of water occurred in 1930 indicating the existing reservoir was too small for its demand. The reservoir was built in 1907 and could not impound enough water for the growing domestic and industrial requirements of the community. The present structure was subsequently designed and constructed at approximately the same location as the original dam. The photographs contained in PennDER File No. 24-35 show the original structure partially destroyed during construction, and it is assumed the entire dam was eventually removed.

According to the correspondence contained in the PennDER file, the original contract was to be let in two sections: Contract No. 1 Building the earthfill embankment and appurtenances, and Contract No. 2 Construction of the steel core wall. However, any contractor could, if he desired, make a combined bid for both contracts. The Williamson Construction Company, Turtle Creek, Pennsylvania was awarded the combined contract on 15 September 1931. The construction started on 6 October 1931 and continued until 8 December 1931 when it was halted due to inclement weather (the inspectors did not want to have any frozen fill incorporated into the embankment). On 13 and 14 December 1931, high water damaged the core steel and concrete that had been placed across the existing channel. On 16 May 1932, the construction company returned to the site and began straightening the damaged core wall. Upon completion of this task on 10 June 1932, the contractor discontinued work. No information was available as to the reason for the work stoppage. The project was abandoned until August 1932 when the bonding company entered into a contract with the Donora Construction Company, Donora, Pennsylvania. This contractor began work on 9 August 1932 and completed construction of the dam on 2 November 1932.

Following damage from water over the principal spillway on 17 March 1936, a stone wall was constructed from the left abutment of the ogee spillway, down the channel, and looped back up around to connect to the head wall of the 36-inch blow-off pipe.

In 1948, the chemical feeder house was removed from the crest of the dam, and the area was regraded and seeded.

2.3 OPERATION

The Borough of Ridgway is responsible for maintenance and operation of the H. B. Norton Dam. There has been no attempt made to regulate the water level of the reservoir. The principal spillway is ungated and there are no flow gauges located downstream. The superintendent does, however, keep a daily log of the depth of water flowing over the spillway.

2.4 EVALUATION

a. Availability - The drawings available from the PennDER files were not listed as "as built." However, from review of the semi-monthly construction reports the drawings appear to be accurate.

b. Adequacy - The information available is generally adequate for a Phase I Inspection.

c. Validity - There is no indication at the present time to doubt the validity of the available engineering data.

SECTION 3 - VISUAL INSPECTION

3.1 FINDINGS

a. General - The dam and its appurtenant structures were found to be in good overall condition at the time of the inspection. Noteworthy deficiencies observed are described briefly in the following paragraphs. The complete visual inspection check list and field sketch are given in Appendix A.

b. Dam - The riprap on the upstream face, from the water level to 4 feet above the water level, has settled due to erosion of the material between and under the sandstone boulders. The crest has eroded from 6 to 12 inches on the upstream face, and erosion has exposed the transition buttresses at both ends of the embankment. On the downstream face just right of the principal spillway, a 2-inch deep gully has developed from approximately mid-height of the dam to the toe. The downstream slope has numerous bush-like plants growing from the crest to the toe. Also, several rodent holes were found on the downstream face (see field sketch for location). No outlets were found for the tile drains.

c. Appurtenant Structures - The emergency spillway concrete has deteriorated and spalled along the sill, and a large crack was observed in the right abutment retaining wall. Cracks were also found in the principal spillway abutments. There was also a crack at the joint of the right abutment and the transition buttress of the emergency spillway. The concrete on the outer surfaces of the screen chamber access located on the crest of the dam showed signs of cracking and spalling. The intakes for the 36-inch and 16-inch cast-iron pipes were inaccessible. However, the outlet structure for the 36-inch pipe encased in concrete appears to be in fair condition and showed no signs of excessive deterioration. The 16-inch outlet to the pump house was also inaccessible and therefore no evaluation could be made of its condition.

d. Reservoir Area - The reservoir slopes were moderate to slightly sloping and are well vegetated. There was no excessive sedimentation noted.

e. Downstream Channel - The downstream channel is relatively free of debris, vegetation or other obstructions. The channel wall on the right side of the principal spillway has a dense growth of trees at the top of the wall. The slope of the downstream channel is mild, averaging approximately 0.2 percent from the tailwater of the dam to the confluence of Big Mill Creek and the Clarion River. Some differential settlement of the stone-lined channel below the principal spillway was observed. Two seepage areas were noted along the sandstone-block wall on the downstream side of the dam (see field sketch for location). The flow from these areas was constant and was estimated at 50 g.p.m. There was no visible evidence that any fines were being carried by this water. The emergency spillway discharge channel consists of an earth channel covered with low grasses, having an average slope of approximately 5 percent. Some wet seep areas were noted below the emergency spillway.

A water treatment plant and the superintendent's residence are located at the downstream toe of the dam, situated between the principal and emergency spillways. When the reservoir level rises above the emergency spillway crest, these structures are surrounded by water and access is cut off. Loss of life would likely result from a failure of the dam because of the proximity of these structures to the dam. Additionally, the reservoir and water treatment plant are the only water supply source for Ridgway Borough and surrounding area. No other habitation is present along Big Mill Creek before its the confluence with the Clarion River.

SECTION 4 - OPERATIONAL PROCEDURES

4.1 PROCEDURES

Operation procedures are generally discussed in paragraphs 1.2.h. and 2.3.

There is no formal written procedure for emergency downstream evacuation in the event of impending catastrophe. However, the superintendent of the water works lives at the dam site and he notifies the city engineer whenever high water is imminent.

It is recommended that a formal emergency procedure be prepared and prominently displayed, and furnished to all operating personnel. This should include:

1) Procedures for evaluating inflow during periods of emergency operation.

2) Who to notify, including public officials, in case evacuation from the downstream area is necessary.

In addition, the owner should assist public officials in developing an emergency evacuation plan for areas which will be inundated by a flood or affected in the event of a dam failure.

4.2 MAINTENANCE OF DAM

The Borough of Ridgway is responsible for maintenance of the dam. The superintendent of water works resides at the dam site, and examines the dam and surrounding area for general maintenance. Maintenance of the dam is generally adequate, except for the tree growth along the left wall of the principal spillway.

4.3 MAINTENANCE OF OPERATING FACILITIES

The operating facilities associated with water supply are maintained on a daily basis by the superintendent of water works. He also periodically operates the gate valve on the 36-inch blow-off pipe and the controls for the screen chamber.

4.4 DESCRIPTION OF ANY WARNING SYSTEM IN EFFECT

There is no warning system or formal emergency procedure in the event of a dam failure. An emergency warning procedure should be developed as recommended in paragraph 4.1.

4.5 EVALUATION OF OPERATIONAL ADEQUACY

The maintenance procedures for the H. B. Norton Dam are generally adequate, except for the above mentioned deficiencies. Periodic inspections of the underwater structure should be performed, and a formal emergency procedure should be developed as recommended in paragraph 4.1.

SECTION 5 - HYDRAULIC/HYDROLOGIC DATA

5.1 EVALUATION OF FEATURES

a. Design Data - No hydrologic or hydraulic design data were available for the preparation of this report. All calculations used in the analysis were generated during the course of this study.

b. Experience Data - The greatest flood of record at the reservoir site occurred during the the period of 16 and 17 March 1942. It is estimated that 0.8 inch of rain fell during the 2 day period. Prior to the storm, however, there was approximately 4 feet of snow on the watershed. The reservoir level peaked at elevation 1420.4 feet, which corresponds to a total spillway discharge of about 5400 c.f.s. The flow from the 36-inch discharge pipe, which was fully opened during the storm, is not included in these calculations.

Another large storm occurred on 17 and 18 July 1942. During the storm, the reservoir rose to an elevation of 1417.6 feet or approximately 31 inches above the principal spillway crest.

No other detailed rainfall/reservoir stage records were available for the preparation of this report.

c. Visual Observations - On the date of the inspection, no conditions were observed that would indicate that the spillway of the dam could not operate satisfactorily in the event of a flood.

d. Overtopping Potential - The H. B. Norton Dam is classified as a "High" hazard-"Intermediate" size dam requiring evaluation for a spillway design flood (SDF) equal to the Probable Maximum Flood (PMF). The 75-foot wide, concrete type, ogee spillway exits into a stone-lined, rectangular-shaped channel. The emergency spillway consists of a 150-foot wide, vegetated channel with a 2-foot wide concrete weir at the control section. The two spillways are capable of discharging 9100 c.f.s. with the reservoir level at the top of dam elevation 1422 feet.

The hydrologic and hydraulic capabilities of the reservoir and spillways were evaluated by routing the PMF and ratios of the PMF through the reservoir

with the aid of the U.S. Army Corps of Engineers Flood Hydrograph Package, HEC-1. The PMF and 1/2 PMF were both found to overtop the dam by average depths of 3.2 and 1.2 feet, respectively. The results of this analysis indicate that the reservoir and spillway are capable of passing a flood approximately equal to 33 percent of PMF without overtopping the dam.

e. Spillway Adequacy - The dam, as outlined in the above analysis would be overtopped by the 1/2 PMF. The criteria, for spillway adequacy determination, requires an estimate of the likelihood of dam failure and an estimate of the downstream damage increase during overtopping by 1/2 PMF conditions. Therefore, the following conditions were used as the limiting criteria which are likely to cause failure of this dam:

1) Depth of overtopping in excess of 1.0 feet.

2) Duration of overtopping in excess of 4 hours.*

3) Approximate maximum velocity of overtopping in excess of 4 f.p.s.*

The overtopping analysis of this dam yielded the following values:

1) 1.2 feet.

2) 6.8 hours.

3) 5.1 f.p.s.

Therefore, dam failure during the above 1/2 PMF conditions is likely to occur.

In order to assess the likelihood of downstream damage, the dam breach option of HEC-1 was utilized to assess the impact of flooding on the treatment plant and operator's residence. The results of the dam breach analysis indicate a maximum outflow

*These parameters will vary according to cover and material conditions of the dam crest.

from the reservoir in excess of 29,000 c.f.s., assuming the dam would be breached during 1/2 PMF compared to only 14,000 c.f.s. assuming the dam remained intact. Therefore because of the proximity of the attendant's residence to the dam, the possibility of loss of life exists in the event of a flood equal in magnitude to 1/2 PMF.

Based on the above results, the spillway is classified as "seriously inadequate" according to the recommended criteria.

It should be noted that conclusions pertain to present day conditions, and that the effect of future development on the hydrology has not been considered.

SECTION 6 - STRUCTURAL STABILITY

6.1 EVALUATION OF STRUCTURAL STABILITY

a. Visual Observations - No structural inadequacies were noted during the visual inspection of the dam. The seepage areas indicated in paragraph 3.1.e. are not considered detrimental to the stability of the dam according to the conditions present at the time of inspection. The seepage from the sandstone wall may be from the area behind the sandstone wall or possibly from the tile drains under the dam that were not outletted properly. The wet areas below the emergency spillway may be a result of natural springs or seeps in the area.

b. Design and Construction Data - Calculations of embankment slope and foundation stability were not available for review. General experience with slopes of heights, inclinations, materials (with inclusion of the steel core wall), and hydraulic conditions similar to those of the dam slopes indicates that these slopes could be shown to satisfy the stability requirements of the "Recommended Guidelines for Safety Inspection of Dams." This inference is supported by empirical guidelines on stable slope inclinations given by the U.S. Bureau of Reclamation (1973) Design of Small Dams, 2nd Edition, pp. 261-267. In view of the height and inclinations of the dam slopes, their history of satisfactory performance, and the fact that no indications of instability were observed during the field inspection of 13 and 14 November 1978; no further stability assessments are necessary for this Phase I Inspection Report.

c. Operating Records - No operation records were available for the H. B. Norton Dam except the daily log of water depth over the principal spillway. Operational procedures obtained from interviewing the superintendent of water works do not indicate cause for concern related to the structural stability of the dam.

d. Post-Construction Changes - The various post-construction changes made to the dam do not appear to adversely affect the structural stability of the structure.

e. Seismic Stability - The dam is located in Zone 1 on the "Seismic Zone Map of the Contiguous United States," Figure 1, page D-30, "Recommended Guidelines for Safety Inspection of Dams." This is a zone of very low seismic activity. As indicated in paragraph 6.1.b., the H. B. Norton Dam could be shown to meet the static stability requirements of the "Recommended Guidelines for Safety Inspection of Dams." Thus, there is no need for further consideration of seismic stability.

SECTION 7 - ASSESSMENT, RECOMMENDATIONS/REMEDIAL MEASURES

7.1 DAM ASSESSMENT

a. Safety - There are no findings as a result of this Phase I Inspection from which a detrimental assessment of the structural stability can be rendered, provided the dam is not overtopped by floodwaters. The H. B. Norton Dam is evaluated as being a "High" hazard-"Intermediate" size dam in accordance with the "Recommended Guidelines for Safety Inspection of Dams" and should have a spillway capacity equal to the PMF. As presented in Section 5, the spillways and reservoir were determined in this investigation to have a capacity much smaller than the PMF. In fact, the capacity was only 33 percent of the PMF and failure is likely to result under less than 50 percent PMF condition. Based on this investigation, the spillway capacity is assessed as "seriously inadequate."

b. Adequacy of Information - The information available and the observations made during the field inspection are considered sufficient for this Phase I Inspection Report.

c. Urgency - The owner should immediately initiate further investigation, as discussed in paragraph 7.1.d.

d. Necessity for Additional Data/Evaluation - The hydraulic/hydrologic analysis performed in connection with this Phase I Inspection Report has indicated the need for additional spillway capacity. It is recommended that the owner of the H. B. Norton Dam immediately initiate an engineering study to further evaluate the spillway capacity and develop recommendations for remedial action as necessary.

7.2 RECOMMENDATIONS/REMEDIAL MEASURES

The inspection and review of information revealed certain items of work which should be performed immediately by the owner. These include:

1) The owner should initiate an engineering study to further evaluate the spillway capacity and develop recommendations for remedial action as necessary.

2) The drain outlets for the tile drain, located in the area behind the steel sheet core wall, should be located and extended to an outlet channel. The quantity and turbidity of all seepage should be monitored and recorded. If conditions indicate the necessity, remedial measures should be taken.

3) The controls for the screen chamber should be maintained to ensure their proper operation.

4) Development of emergency operations procedures for the reservoir including:

    a) Method of draining the reservoir under emergency conditions.

    b) Constant monitoring of the dam when large overflows are observed at the principal spillway.

    c) Who to notify, including public officials, in case evacuation from the downstream area is necessary.

    d) The installation of a reliable flood warning system in all areas downstream of the dam which would be affected in the event of the failure of the dam.

In addition, the owner should assist public officials in developing an emergency evacuation plan for areas which will be affected in the event of a flood or dam failure.

The inspection and review of information revealed other items of work which should be accomplished in the near future by the owner. These include:

1) The eroded areas should be graded, treated and seeded with an appropriate seeding mixture to prevent erosion.

2) The riprap should be restored to its original position with a granular cushion/filter under the riprap.

3) Weep holes should be placed at the base of the sandstone wall to drain the possibly impounded area.

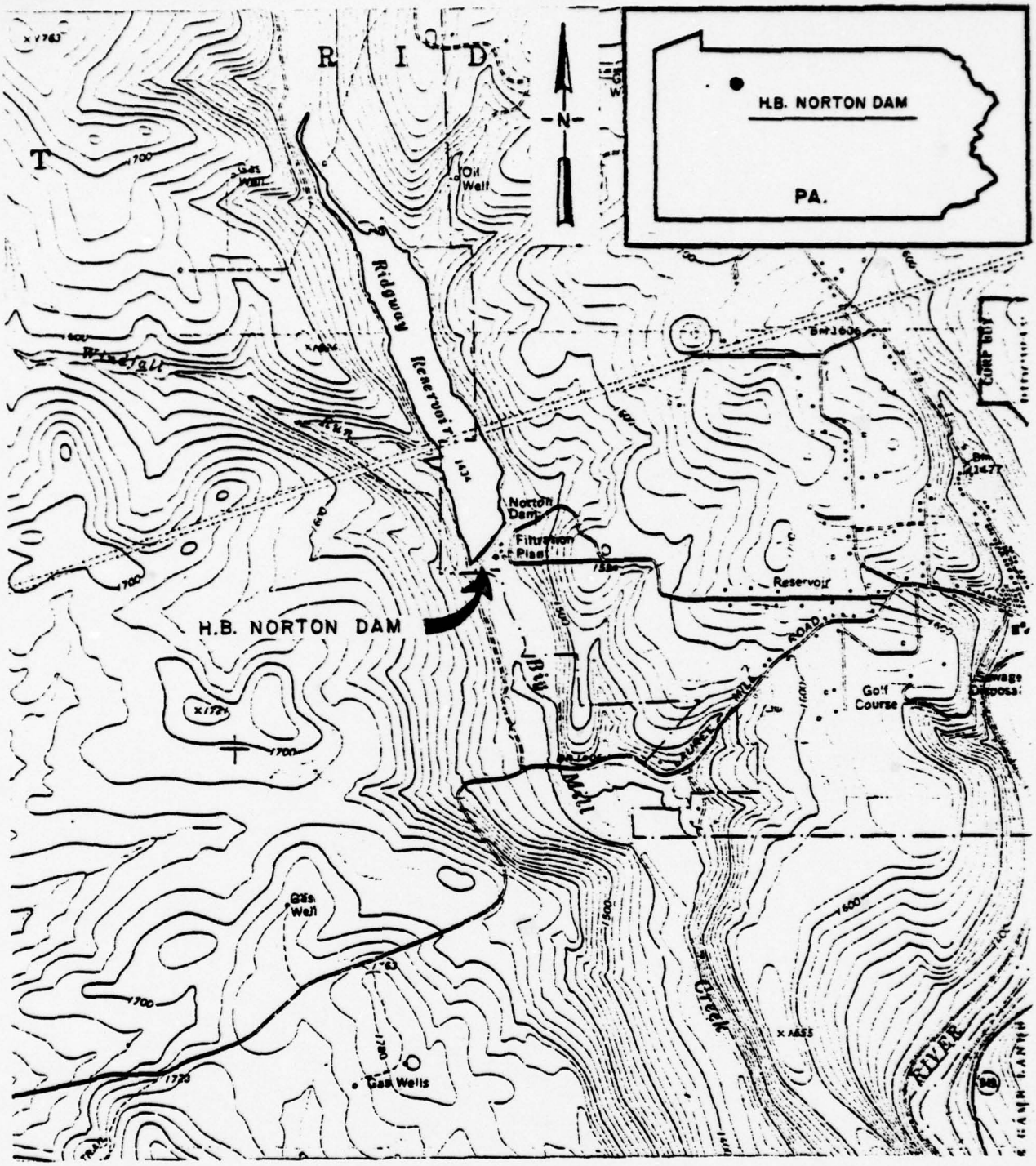
4) The trees along the top of the wall of the downstream principal spillway (right side) should be removed or trimmed to facilitate future inspection of the wall.

5) The bush-like vegetation that is on the downstream slope should be removed, and the slope should be treated and seeded with an appropriate mixture to prevent erosion.

6) The concrete wing walls, transition buttresses, and spillways should be repaired where cracking and spalling has occurred.

The owner should continue in the future to inspect the embankment and concrete appurtenances, and repair as necessary.

PLATES



SCALE 1:24000

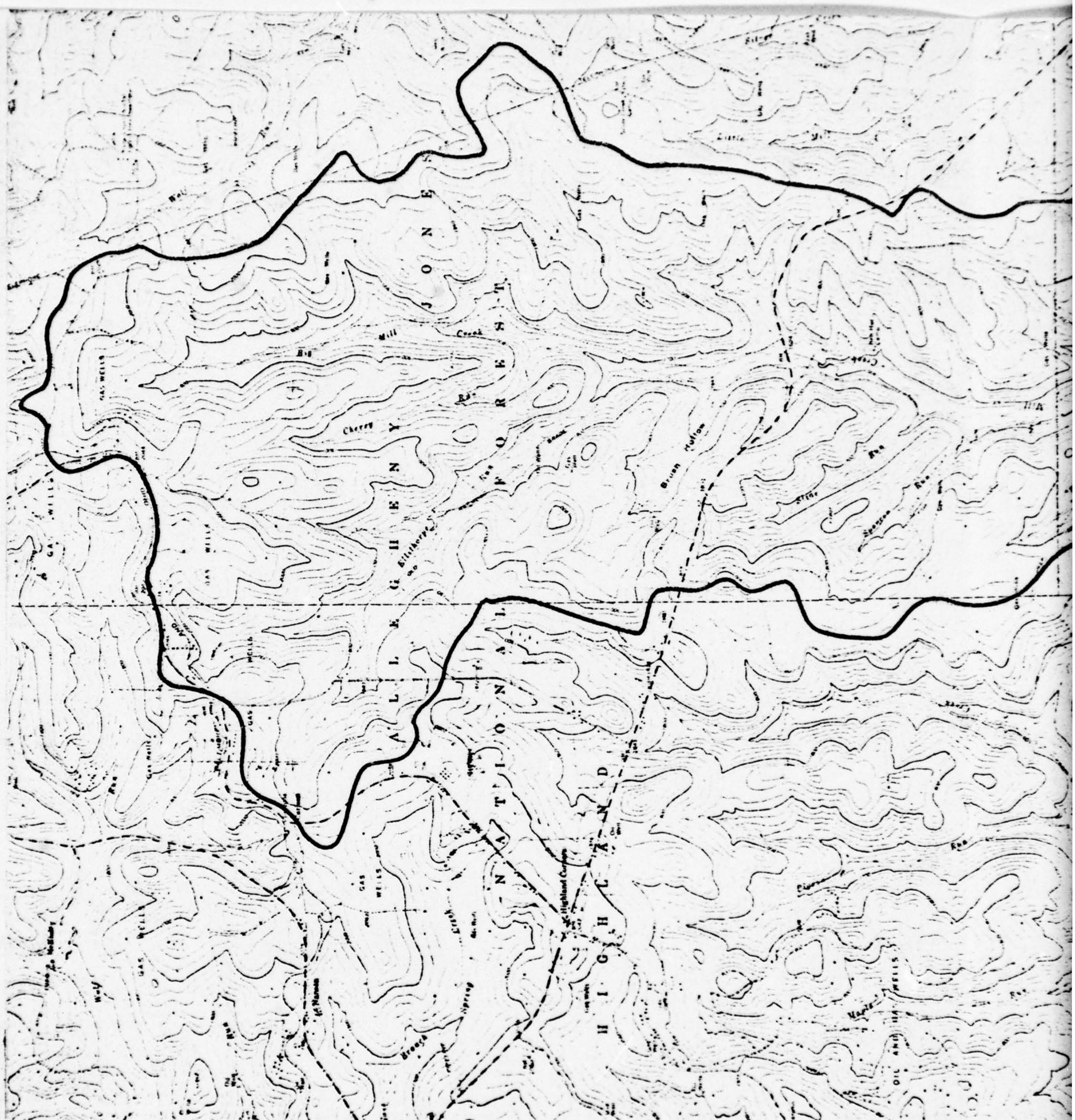
1 1/2 0 1 MILE

1000 0 1000 2000 3000 4000 5000 6000 7000 FEET

1 .5 0 1 KILOMETER

PLATE 1 LOCATION PLAN

H. B. NORTON DAM


ALLEGHENY NATIONAL FOREST
HIGHLAND
Big Mill Creek
Cherry Run
GAS WELLS
OIL AND GAS WELLS

SC

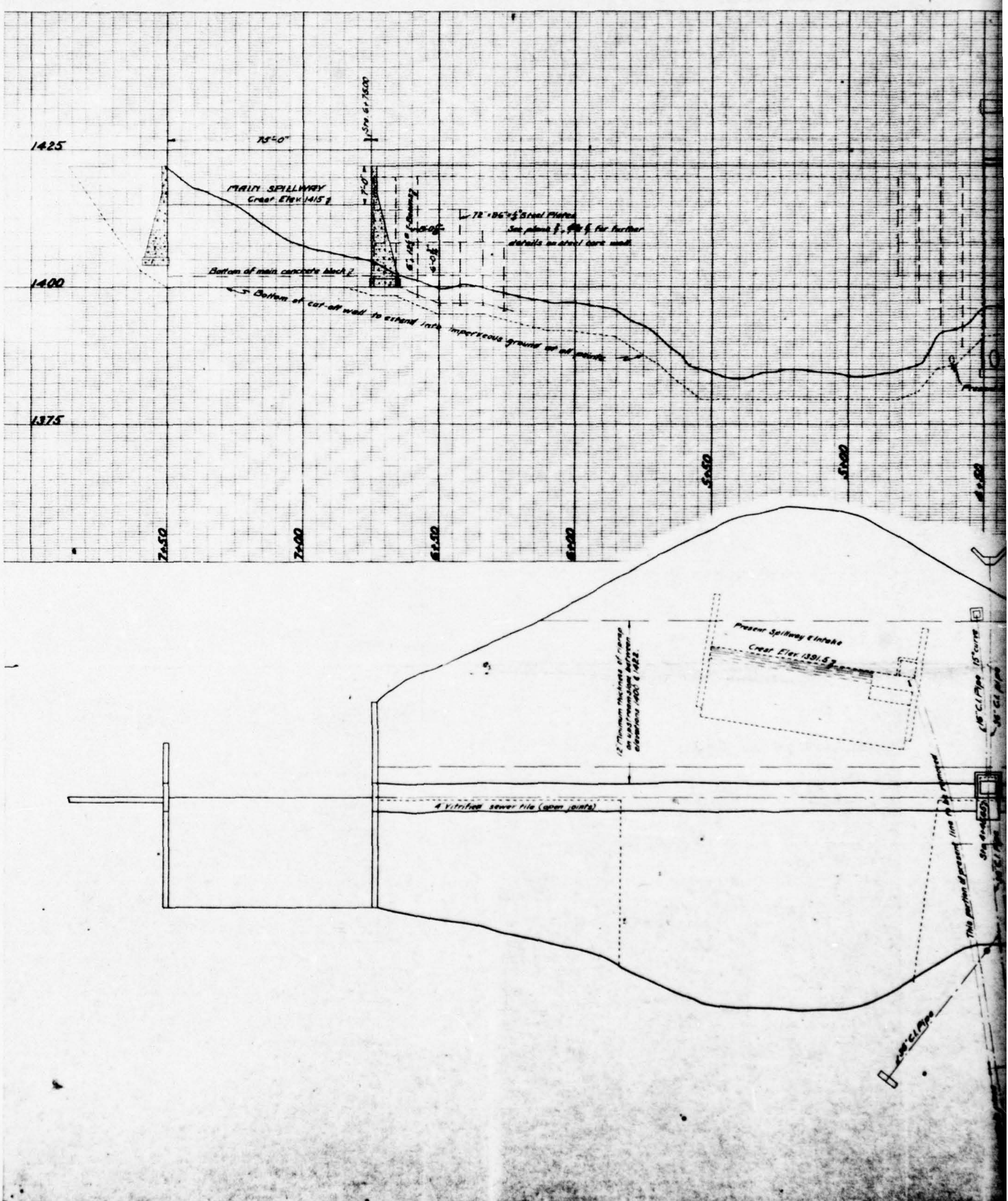
SCALE 1:24000

1 2 3 4 5 6 7 THOUSANDS OF FEET

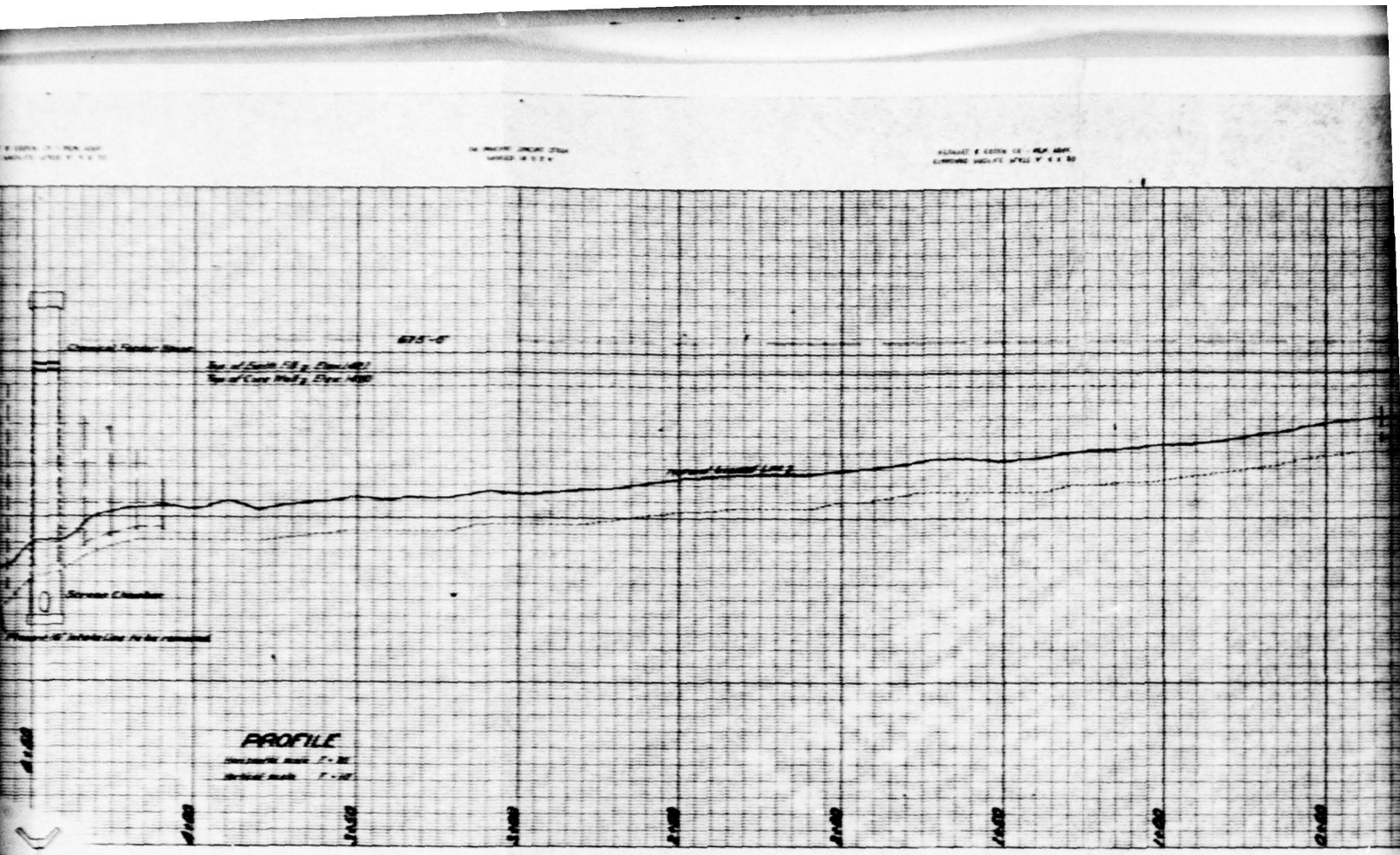
PLATE 2 WATERSHED MAP

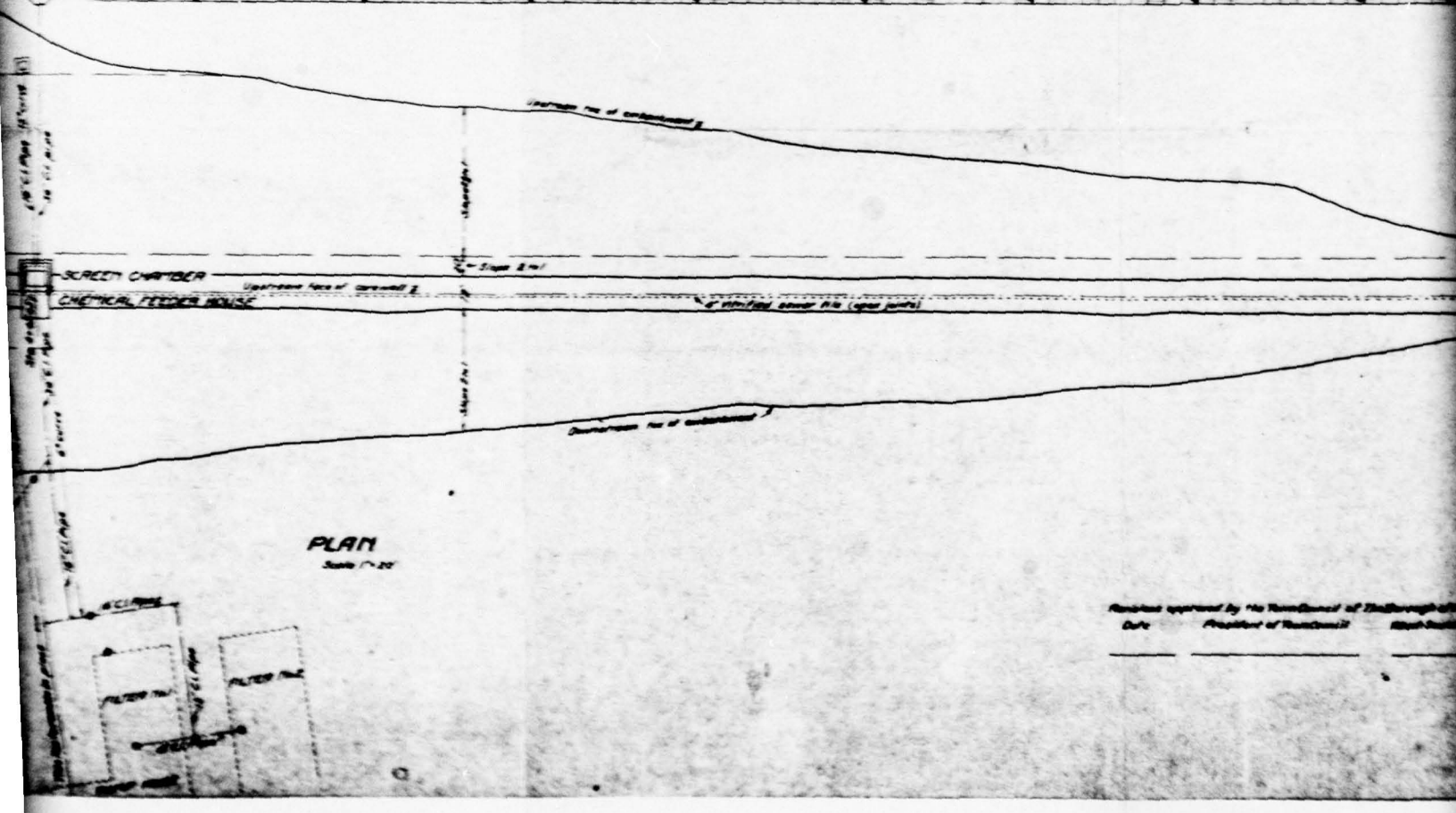
H.B. NORTON DAM

2A
1

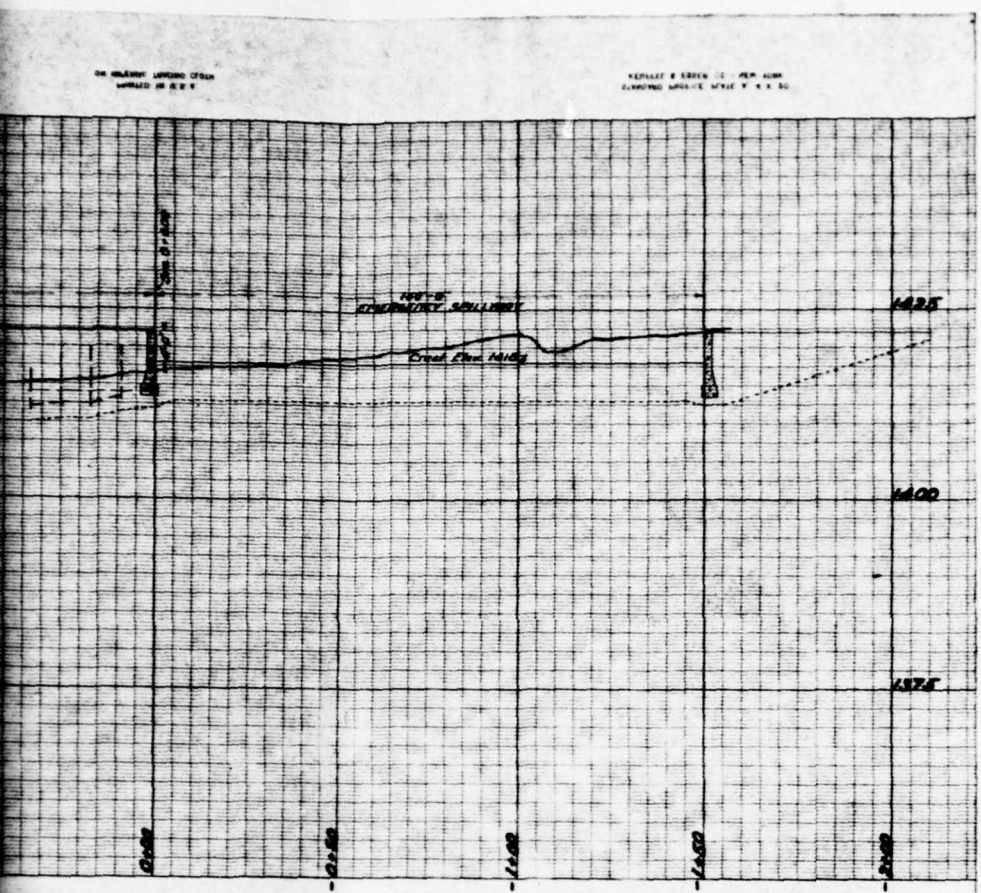

1425
1400
1375
75'-0"
MAIN SPILLWAY
Crest Elev. 1415 ±
Bottom of main concrete block ±
Bottom of cut-off wall to extend into impervious ground at all points
7+50
7+00
6+50
6+00
5+50
5+00
Present Spillway & Intake
Crest Elev. 1391.5 ±
4" Vitrified sewer tile (open joints)

1





2



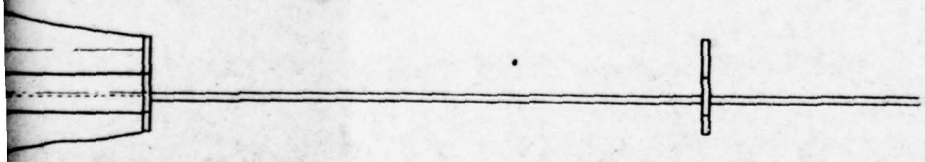


PLATE 3

RIDGWAY BOROUGH WATER WORKS

RIDGWAY, PA.

1931 EXTENSION

DAM

SECTION AND PLAN

Approved by the Town Council of the Borough of Ridgway at its meeting held July 14, 1931.

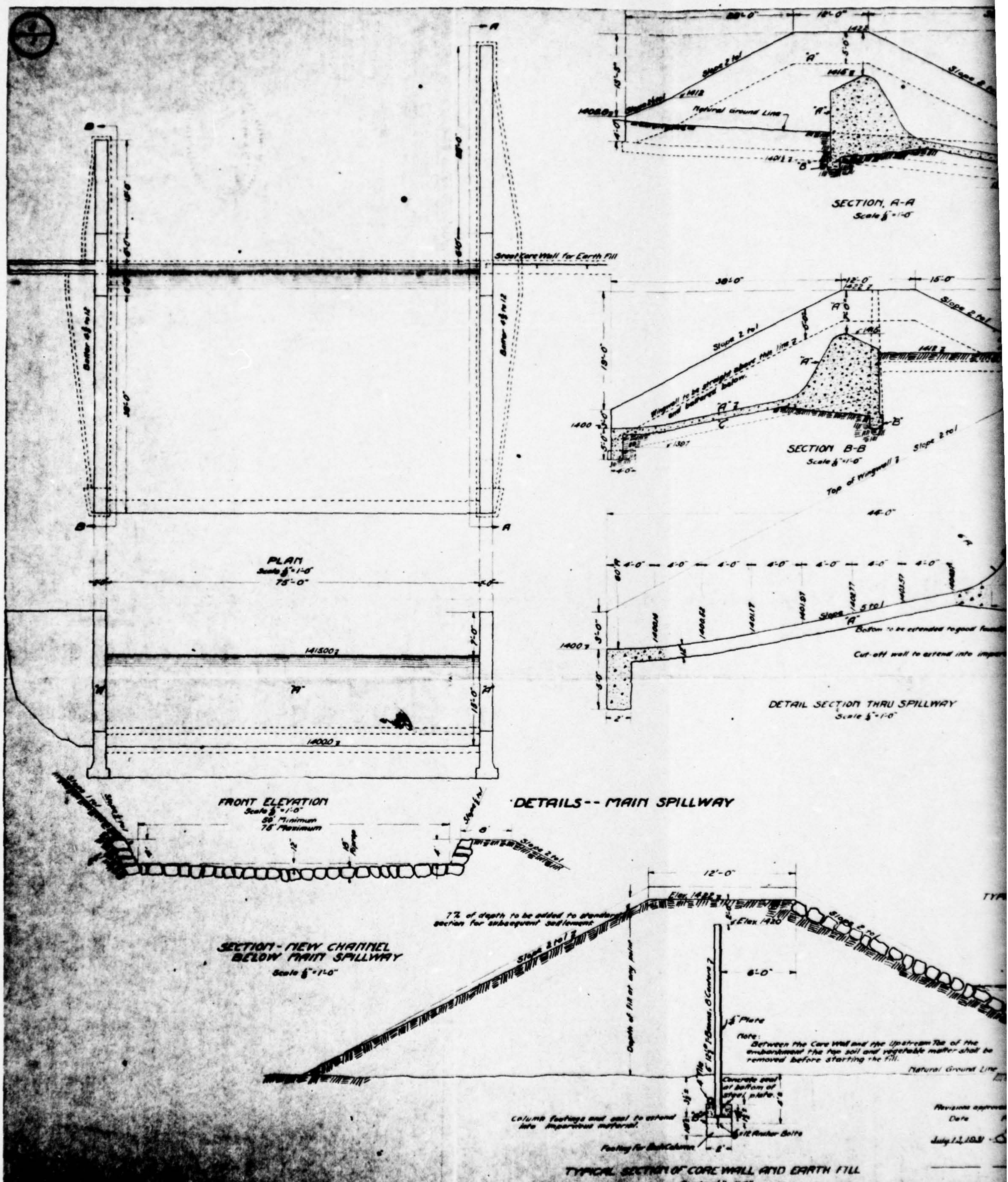
Geo. Lenhart
President of Town Council

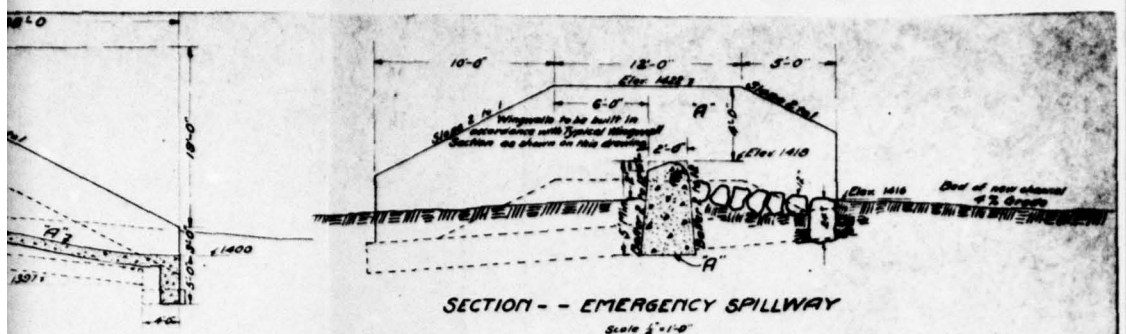
Attest: [illegible]
Secretary of Town Council

NOTE:
This drawing supersedes drawing no. 4 which was approved by the Town Council May 11, 1931.

2A/1

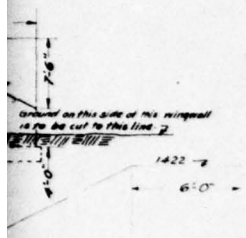
B

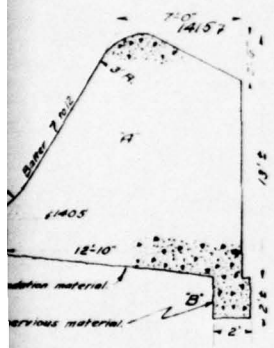

DETAILS -- MAIN SPILLWAY
SECTION, A-A
Scale 1/8" = 1'-0"
Slope 2 to 1
Natural Ground Line
SECTION B-B
Scale 1/8" = 1'-0"
Wingwall to be straight above the line and battered below.
Top of Wingwall
Steel Core Wall for Earth Fill
Batter of 3 in 12
PLAN
Scale 1/8" = 1'-0"
75'-0"
FRONT ELEVATION
Scale 1/8" = 1'-0"
50' Minimum
75' Maximum
DETAIL SECTION THRU SPILLWAY
Scale 1/8" = 1'-0"
Slope 5 to 1
Bottom to be extended to good foundation
Cut-off wall to extend into impervious
SECTION - NEW CHANNEL BELOW MAIN SPILLWAY
Scale 1/8" = 1'-0"
7% of depth to be added to standard section for subsequent settlement
Elev. 1422
Elev. 1420
Depth of fill at any point
Plate
Note: Between the Core Wall and the Upstream Toe of the embankment the top soil and vegetable matter shall be removed before starting the fill.
Natural Ground Line
Concrete seal at bottom of steel plate
Column footings and seal to extend into impervious material.
Footing for Bolt Column
Anchor Bolts
TYPICAL SECTION OF CORE WALL AND EARTH FILL
Revisions approved
Date
July 13, 1931

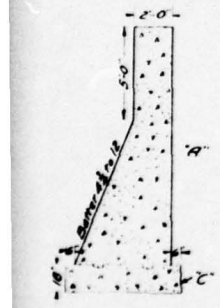


SECTION - - EMERGENCY SPILLWAY

Scale ¼"=1'-0"







PICAL WINGWALL SECTION

Scale ¼"=1'-0"

NOTE:
A = Class A Concrete
B = Class B Concrete
C = Class C Concrete

Flow Line & Elev 1415 (Top of Spillway)

1422

Stone Fill

Elev 1400

d by the Town Council of The Borough of Ridgway at its meeting held:

President of Town Council

Attest Secretary of Town Council

Geo Luecheinger

PLATE 4

RIDGWAY BOROUGH WATER WORKS

RIDGWAY, PA.

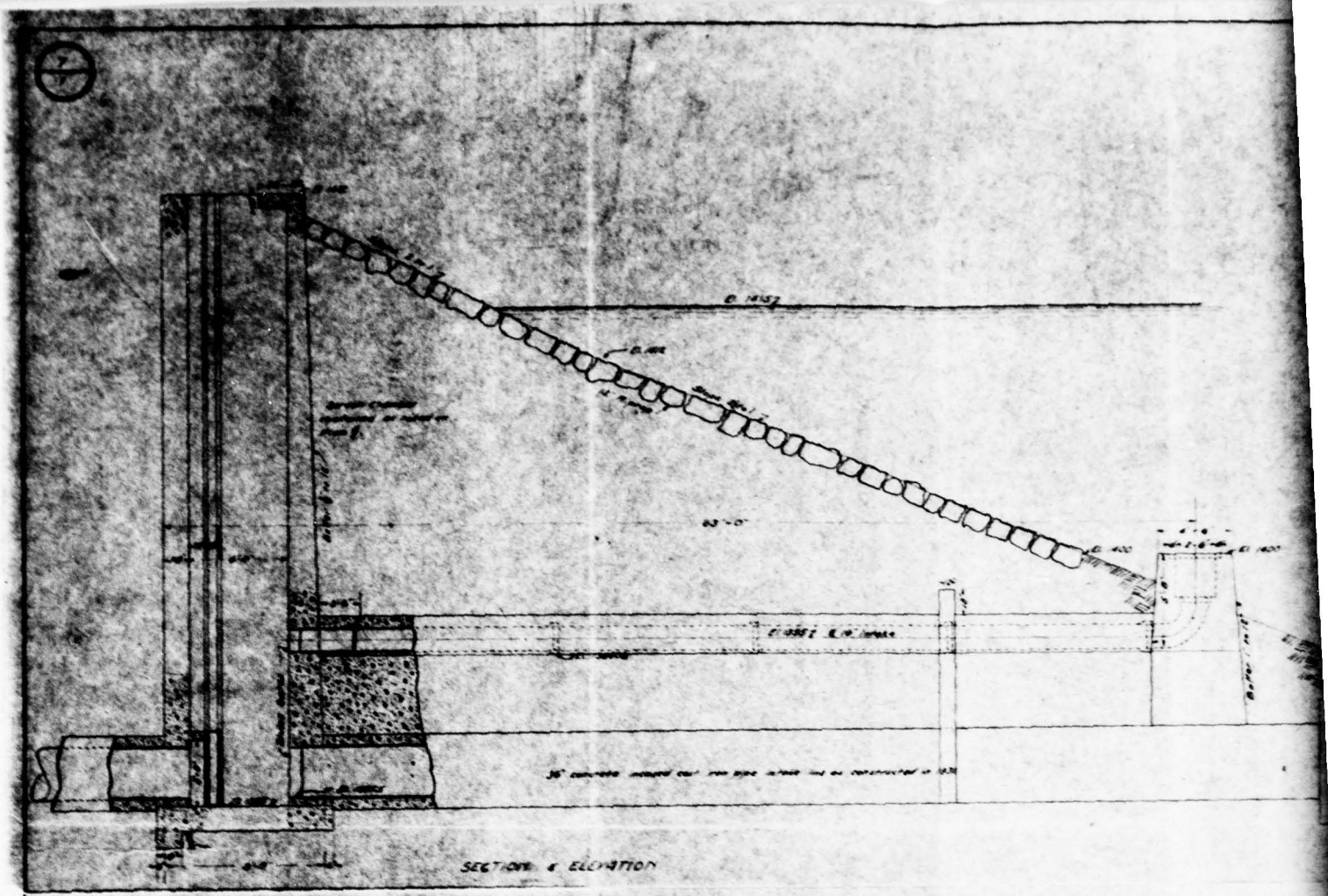
1931 EXTENSION

SPILLWAY DETAILS
EARTH FILL SECTION

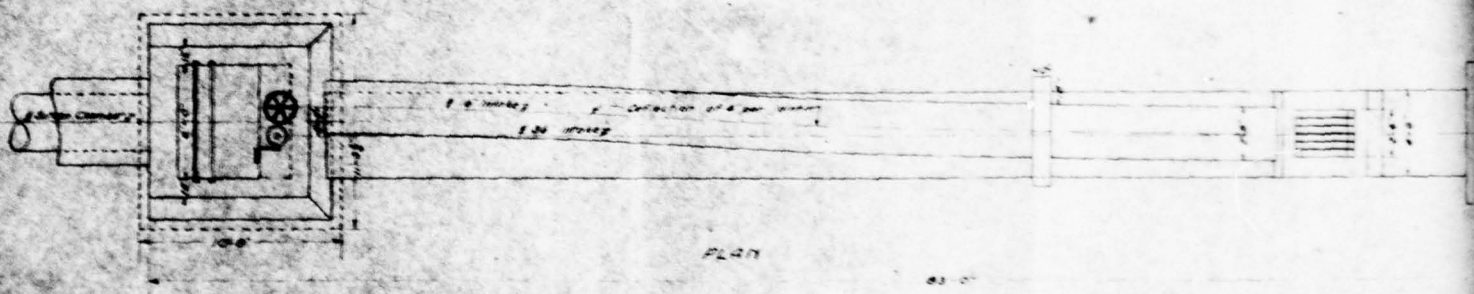
Approved by the Town Council of The Borough of Ridgway at its regular meeting held May 11, 1931.

President of Town Council

Attest Secretary of Town Council



SECTION & ELEVATION

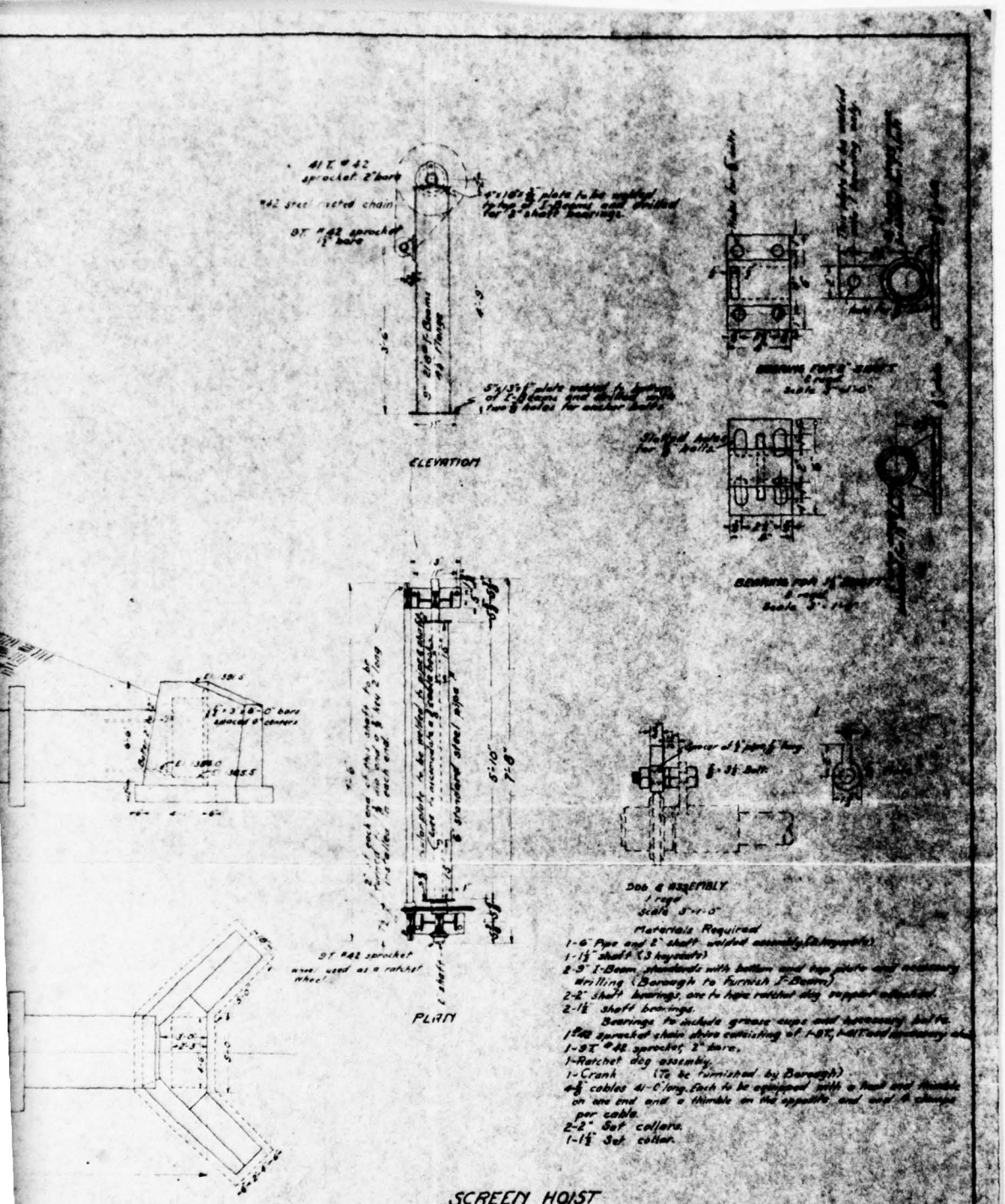


PLAN

SCREEN CHAMBER & INTAKE LINES

Scale 1/4"=1'-0" Aug. 1932

NOTE
Location and details of 16" intake leg to waterline will be shown on drawing 5.
Details of 36" intake pipe and headwall and screen arrangement marked "as constructed in 1931".



Dog & Assembly
1 regd
Scale 3"=1'-0"

Materials Required

1-6" Pipe and 2" shaft welded assembly (3 keyseats)
1-1½" shaft (3 keyseats)
2-9" I-Beam shackands with bottom and top plates and necessary drilling (Borough to furnish I-Beams)
2-2" shaft bearings, one to have ratchet dog support welded
2-1½" shaft bearings.
Bearings to include grease cups and necessary bolts.
1-48 Sprocket chain above consisting of 1-87½ half and necessary ch
1-9T #42 sprocket 2" bore.
1-Ratchet dog assembly.
1-Crank (To be furnished by Borough)
4-⅝ cables 41-0" long. Each to be equipped with a hook and thimble on one end and a thimble on the opposite end and use 4 clamps per cable.
2-2" Set collars.
1-1½" Set collar.

SCREEN HOIST

PLATE 5

RIDGWAY BOROUGH WATER WORKS

RIDGWAY, PA.

1931 EXTENSION

REVISIONS & ADDITIONS

APPENDIX A

CHECK LIST - VISUAL INSPECTION AND FIELD SKETCH

Check List
Visual Inspection
Phase 1

Name of Dam H.B. Norton Dam (PA No Name #42) County Elk State PA Coordinates Lat. N 41°25.4'

NDI # PA 00385
PennDER # 24-35

Long. W 78°46.8'

Dates Inspection 13 and 14 November 1978 Weather Overcast, Rainy Temperature 55°F.

Pool Elevation at Time of Inspection 1415.3 ft. M.S.L.* Tailwater at Time of Inspection 1385 ft. M.S.L.*

*Plan datum - taken from design plans dated July 1931. The plan datum is approximately 19 ft. lower than the N.G.S. datum.

Inspection Personnel:

Michael Baker, Jr., Inc.:

James G. Ulinski
Rodney E. Holderbaum
David F. Johns

Owner's Representatives:

Richard Herzog, Superintendent

David F. Johns Recorder

CONCRETE/MASONRY DAMS (N/A)

Name of Dam: H.B. NORTON

NDI # PA 00385

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
LEAKAGE		
STRUCTURE TO ABUTMENT/EMBANKMENT JUNCTIONS		
DRAINS		
WATER PASSAGES		
FOUNDATION		

CONCRETE/MASONRY DAMS (N/A)

Name of Dam: H.B. NORTON
NDI # PA 00385

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
SURFACE CRACKS CONCRETE SURFACES		
STRUCTURAL CRACKING		
VERTICAL AND HORIZONTAL ALIGNMENT		
MONOLITH JOINTS		
CONSTRUCTION JOINTS		

EMBANKMENT

Name of Dam: H.B. NORTON
NDI # PA 00385

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
SURFACE CRACKS	None were observed.	
UNUSUAL MOVEMENT OR CRACKING AT OR BEYOND THE TOE	None were observed.	
SLOUGHING OR EROSION OF EMBANKMENT AND ABUTMENT SLOPES	The transition buttress cutoff walls on both sides of the principal and emergency spillways were exposed due to erosion of the material on the crest of the dam. The downstream slope is undulated across its length. On the downstream slope left of the principal spillway, a small 2-in. gully has eroded below an ant hill. Several animal holes were noted along the downstream slope.	The eroded areas should be graded, treated and seeded with an appropriate seeding mixture to prevent erosion. The large bush-like vegetation that is on the downstream slope should be removed, and the slope should be treated and seeded with an appropriate mixture to prevent erosion.
VERTICAL AND HORIZONTAL ALIGNMENT OF THE CREST	The crest on the upstream side is eroded from 6 to 12 in.	The crest area should be graded, treated and seeded with an appropriate seeding mixture to prevent erosion.
RIPRAP FAILURES	Several locations of the riprap on the upstream face at the water level to 4 ft. above it have settled due to erosion of the material between and under the boulders.	The riprap should be restored to its original position with a granular cushion/filter under the riprap.

EMBANKMENT

Name of Dam: H.B. NORTON
NDI # PA 00385

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
JUNCTION OF EMBANKMENT AND ABUTMENT, SPILLWAY AND DAM - RIGHT SPILLWAY ABUTMENT	A dense stand of trees has grown along the top of the principal spillway wall on the right side of the downstream channel.	It is desirable to trim or remove the trees to facilitate the future inspection of the spillway wall.
ANY NOTICEABLE SEEPAGE	A seepage area was noted along the sandstone block wall on the downstream side of the dam (see field sketch plan for location). The flow from these areas was constant and estimated at 50 g.p.m. There was no visible evidence that fines were being carried by this water.	It is recommended that weep holes be placed at the base of the sandstone wall to drain the impounded area.
	Seep areas were observed on the downstream side of the emergency spillway. The access road crosses this area approximately 300 ft. below the spillway crest, and a 12-in. culvert has to drain the area. A small flow of about 0.5 g.p.m. was observed flowing through the culvert.	The exact cause of the seepage could not be determined, however, three possibilities exist for the situation: 1) The average elevation of the area is almost the same as that of the normal pool and no cutoff was installed below the emergency spillway. 2) The photos taken during the original construction show the area as wet which may indicate the existance of natural springs or seeps in the area, or 3) There is a small stream on the hillside just above the area. The stream enters the lake just south of the left abutment of the emergency spillway.

EMBANKMENT

Name of Dam: H.B. NORTON
NDI # PA 00385

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
STAFF GAGE AND RECORDER	N/A	
DRAINS	According to the plans (see Plate 3), a 4-in. tile drain was to be located behind the steel sheet core wall. However, no outlets were found for these drains.	The drain outlets should be located and extended to an outlet channel.

OUTLET WORKS

Name of Dam: H.B. NORTON
NDI # PA 00385

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
CRACKING AND SPALLING OF CONCRETE SURFACES IN OUTLET CONDUIT	The 36-in. cast-iron pipe encased in concrete appears to be in fair condition at the outlet. The 16-in. water supply pipe is inaccessible.	
INTAKE STRUCTURE	The intake for both the 36-in. and 16-in. pipe is inaccessible. Access to the screen chamber is obtained at the crest of the dam. The concrete on the outer surfaces of the chamber shows signs of cracking and spalling.	The deterioration of the concrete is not excessive considering the age of the structure. To prevent against further deterioration, however, the concrete should be repaired.
OUTLET STRUCTURE	The concrete head wall at the 36-in. blow-off exit shows no sign of excessive deterioration.	
OUTLET CHANNEL	The earth outlet channel exits into the principal spillway stilling basin about 200 ft. downstream of the outlet pipe. The mildly sloping channel is free of debris and other obstructions.	
EMERGENCY GATE	The emergency gate is a hand-operated sluice gate located at the screen chamber on the crest of the dam.	The emergency gate should be operated periodically as part of an annual inspection of the dam.

UNGATED SPILLWAY

Name of Dam: H.B. NORTON
NDI # PA 00385

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
CONCRETE WEIR	Principal spillway consists of a 75-ft. wide concrete ogee-section. The spillway abutments are cracked in several locations. There is also a crack at the joint of the right abutment and training wall. The 2-ft. wide, 150-ft. long concrete sill at the emergency spillway shows signs of cracking and spalling at several locations. There is a 10-ft. wide strip of cut stone riprap on the downstream side of the sill which is in fairly good condition.	The concrete on both spillways should be repaired.
APPROACH CHANNEL	The approach channel to the principal spillway is free of debris, erosion and obstructions. The approach to the emergency spillway consists of earth and low grasses. No obstruction or serious erosion was noted.	
DISCHARGE CHANNEL	The principal spillway channel is stone-lined, approximately 230 ft. long, and 75 ft. wide. Some differential settlement of the stone was observed. This channel exits into a natural stilling pool. Both the stilling pool and channel are relatively free of debris and other obstructions. The emergency spillway discharge channel consists of an earth channel covered with low grasses, having an average slope of about 5%. This channel joins Big Mill Creek several hundred feet downstream. No debris or obstructions were located in the channel.	The differential settlement of the stone does not appear to be a serious problem.
BRIDGE AND PIERS	N/A	

GATED SPILLWAY (N/A)

Name of Dam: H.B. NORTON

NDI # PA 00385

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
CONCRETE SILL		
APPROACH CHANNEL		
DISCHARGE CHANNEL		
BRIDGE AND PIERS		
GATES AND OPERATION EQUIPMENT		

INSTRUMENTATION

Name of Dam: H.B. NORTON

NDI # PA 00385

VISUAL EXAMINATION	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
MONUMENTATION/SURVEYS	None	
OBSERVATION WELLS	None	
WEIRS	None	
PIEZOMETERS	None	
OTHER	Not Applicable	

RESERVOIR

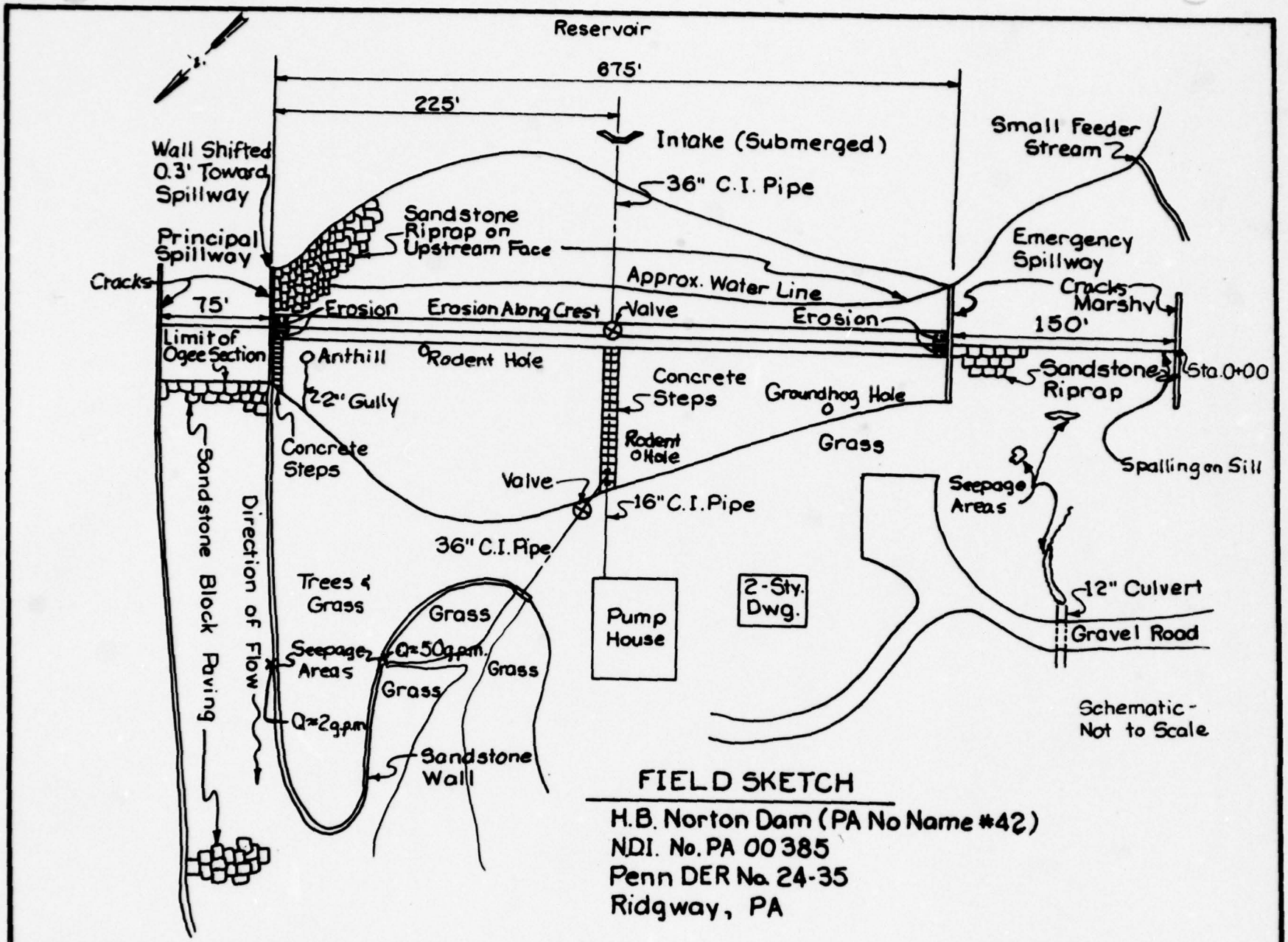
Name of Dam: H.B. NORTON
NDI # PA 00385

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
SLOPES	The reservoir slopes were moderate to slightly sloping and are well vegetated.	
SEDIMENTATION	No excessive sedimentation was noted.	

DOWNSTREAM CHANNEL

Name of Dam: H.B. NORTON
NDI # PA 00385

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
CONDITION (OBSTRUCTIONS, DEBRIS, ETC.)	The downstream channel is relatively free of debris, vegetation or other obstructions.	
SLOPES	The slope of the downstream channel is mild, averaging approximately 0.2% from the tailwater of the dam to the confluence with the Clarion River.	
APPROXIMATE NO. OF HOMES AND POPULATION	One residence is located immediately below the dam. No other homes are located in the downstream floodplain.	



FIELD SKETCH

H.B. Norton Dam (PA No Name #42)
N.D.I. No. PA 00385
Penn DER No. 24-35
Ridgway, PA

APPENDIX B

CHECK LIST - ENGINEERING DATA

CHECK LIST
ENGINEERING DATA
DESIGN, CONSTRUCTION, OPERATION

Name of Dam: H.B. NORTON
NDI # PA 00385

ITEM	REMARKS
PLAN OF DAM	See Plate 3 - Ridgway Borough Water Works: Dam Section and Plan.
REGIONAL VICINITY MAP	See Plate 1, a U.S.G.S. 7.5 minute quadrangle map showing dam location with state location inset.
CONSTRUCTION HISTORY	Designed by H.B. Norton of the Elk Tanning Company and N.W. Rood. Construction was started on 7 October 1931 by the Williamson Construction Company, 223 Monroeville Rd. Turtle Creek, Pa. The work continued until 8 December 1931 at which time work was stopped due to winter weather. Construction resumed on 16 May 1932 and continued until 10 June 1932. No reason for the stoppage appeared in any of the correspondence. The bonding company then engaged Donora Construction Company, Donora, Pa. to finish construction. Donora Construction Company commenced work on 9 August 1932 and worked until completion of the dam on 2 November 1932.
TYPICAL SECTIONS OF DAM	See Plate 4 - Ridgway Borough Water Works: Spillway Details - Earthfill Sections.
HYDROLOGIC/HYDRAULIC DATA	No information available.
OUTLETS - PLAN	See Plate 5 - Ridgway Borough Water Works: Outlet Works.
- DETAILS	See Plate 5 - Ridgway Borough Water Works: Outlet Works.
- CONSTRAINTS	One 16-in. intake and one 36-in. intake to chamber at center of dam. From this point, only one 36-in. outlet pipe to downstream toe of the embankment. At the downstream toe a 16-in. water supply line runs from the outlet pipe to the water treatment plant, and the 36-in. outlet pipe has a control valve.
- DISCHARGE RATINGS	None available
RAINFALL/RESERVOIR RECORDS	None available

Name of Dam: H.B. NORTON
NDI # PA 00385

ITEM	REMARKS
DESIGN REPORTS	None available
GEOLOGY REPORTS	None available
DESIGN COMPUTATIONS HYDROLOGY & HYDRAULICS DAM STABILITY SEEPAGE STUDIES	None available
MATERIALS INVESTIGATIONS BORING RECORDS LABORATORY FIELD	None available
POST-CONSTRUCTION SURVEYS OF DAM	No information available.
BORROW SOURCES	No information available.

Name of Dam: H.B. NORTON
NDI # PA 00385

ITEM	REMARKS
MONITORING SYSTEMS	None
MODIFICATIONS	The chemical feeder house located on the crest of the dam had been removed sometime prior to 1940. No information was available as to the exact date or reason for the removal. Steps were added along the downstream wing wall of the principal spillway. A sandstone wall was built from the right abutment of the downstream side of the principal spillway, down the channel and looped around, and connected to the head wall of the 36-in. blow-off pipe (see field sketch plan for location).
HIGH POOL RECORDS	From information contained in a letter from Albert C. Wathli of the Street and Water Commission of Ridgway, Pa. to Charles E. Ryder, Pa. Department of Forests and Waters on 17 March 1936, the maximum depth reached was 5' 4 1/2" of flow over the regular spillway and 28' 1/2" of flow over the emergency spillway. The 36-in. blow-off pipe was wide open and had approximately 30 ft. of head at that time.
POST-CONSTRUCTION ENGINEERING STUDIES AND REPORTS	After construction of the dam, various inspections were performed by PennDER personnel, including the last one performed in 1965. Reports on these inspections are contained in the PennDER file for this dam.
PRIOR ACCIDENTS OR FAILURE OF DAM DESCRIPTION REPORTS	None available
MAINTENANCE OPERATION RECORDS	None available

Name of Dam: H.B. NORTON
NDI # PA 00385

ITEM	REMARKS
SPILLWAY PLAN	See Plate 4
SECTIONS	See Plate 4
DETAILS	See Plate 4
OPERATING EQUIPMENT PLANS & DETAILS	See Plate 5

CHECK LIST
HYDROLOGIC AND HYDRAULIC DATA
ENGINEERING DATA

DRAINAGE AREA CHARACTERISTICS: 30.1 sq.mi. (primarily forested)

ELEVATION TOP NORMAL POOL (STORAGE CAPACITY): 1415 ft. (617 ac.-ft.)

ELEVATION TOP FLOOD CONTROL POOL (STORAGE CAPACITY): 1421.9 ft. (1253 ac.-ft.)

ELEVATION MAXIMUM DESIGN POOL: Unknown

ELEVATION TOP DAM: 1421.9 ft. (minimum elevation), 1422.4 ft. (average elevation)

CREST: Principal Spillway

a. Elevation 1415.0 ft.
b. Type Concrete ogee spillway exiting into retangular channel
c. Width 75 ft.
d. Length Approximately 265 ft.
e. Location Spillover At right end of embankment
f. Number and Type of Gates N/A

CREST: Emergency Spillway

a. Elevation 1418 ft.
b. Type Vegetated channel with concrete sill at control section
c. Width 150 ft. at crest
d. Length Approximately 600 ft.
e. Location Spillover At left end of dam
f. Number and Type of Gates N/A

OUTLET WORKS: 36-in. blow-off pipe, 16-in. water supply pipe

a. Type 36-in. C.I.P. encased in concrete and 16-in. C.I.P.
b. Location 300 ft. from right abutment
c. Entrance inverts 1386.0 ft. (blow-off), 1400.0 ft. (water supply)
d. Exit inverts 1385.1 ft. (blow-off), water supply pipe unknown
e. Emergency draindown facilities 36-in. sluice gated blow-off pipe hand-operated at crest of dam

HYDROMETEOROLOGICAL GAGES: N/A

a. Type
b. Location
c. Records

MAXIMUM NON-DAMAGING DISCHARGE Unknown

APPENDIX C

PHOTOGRAPHS

DETAILED PHOTOGRAPH DESCRIPTIONS

Overall View of Dam -
Top Photo - View from Right Abutment
(Supervisor's house just below the dam; water pumping station is to the right of the house; blow-off pipe exits in tree-lined cut below embankment.)
Lower Photo - View from Left Abutment

Photo 1 - View of Emergency Spillway Looking Left to Right from Crest of Dam
(Note cracking of concrete and erosion of crest along wing wall.)

Photo 2 - View of Emegency Spillway Outlet Channel

Photo 3 - View of Principal Spillway Looking Upstream
(Showing the 5-foot sandstone wall and the dense stand of trees growing on the right side channel wall.)

Photo 4 - View Showing Ogee Weir Spillway
(Note cracks along wing wall.)

Photo 5 - View of Head Wall of 36-Inch Blow-Off Pipe
(Note the bush-like vegetation on the downstream embankment. The valve used to regulate the flow of the 36-inch pipe is located at the base of the slope adjacent to the steps.)

Photo 6 - View Looking Downstream Along Outlet Pipe Discharge Channel
(Flow from the seepage area can be seen flowing right to left from wall into mainstream from blow-off pipe.)

Photo 7 - View of Downstream Embankment Showing Vegetation

Photo 8 - View Looking at Crest and Upstream Slope
(Showing sandstone riprap and crest erosion just behind surveyor.)

Photo 9 - View Looking Downstream at Seepage Area
(Flow from seepage area can be seen flowing right to left into mainstream from blow-off pipe.)

Photo 10 - View of Seepage Through Sandstone Wall on Left Side of Ogee Spillway Channel

Note: Photographs were taken on 14 November 1978.

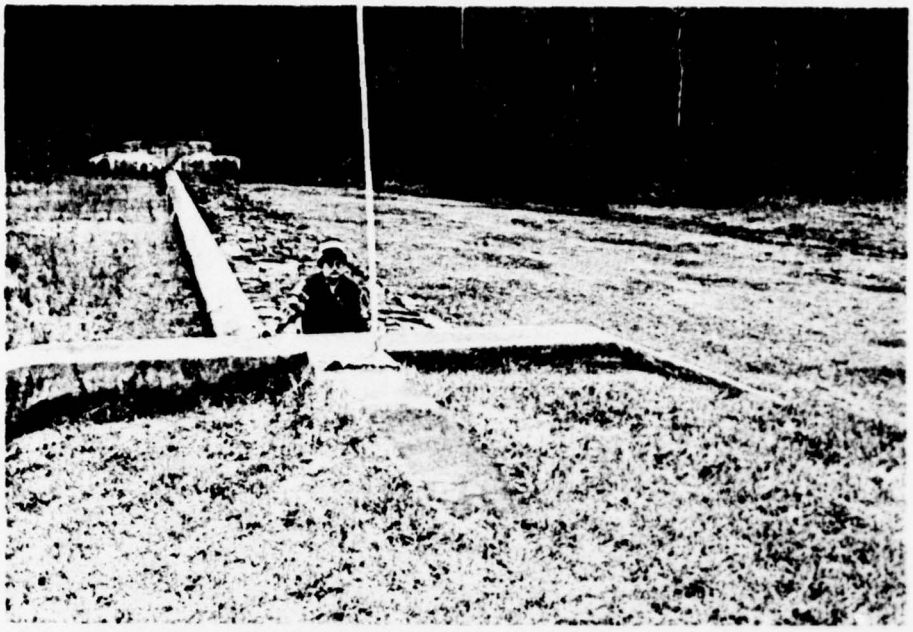


PHOTO 1. View of Emergency Spillway Looking Left to Right from Crest of Dam

PHOTO 2. View of Emergency Spillway Outlet Channel

PHOTO 3. View of Principal Spillway Looking Upstream

PHOTO 4. View Showing Ogee Weir Spillway

PHOTO 5. View of Head Wall of 36-Inch Blow-Off Pipe

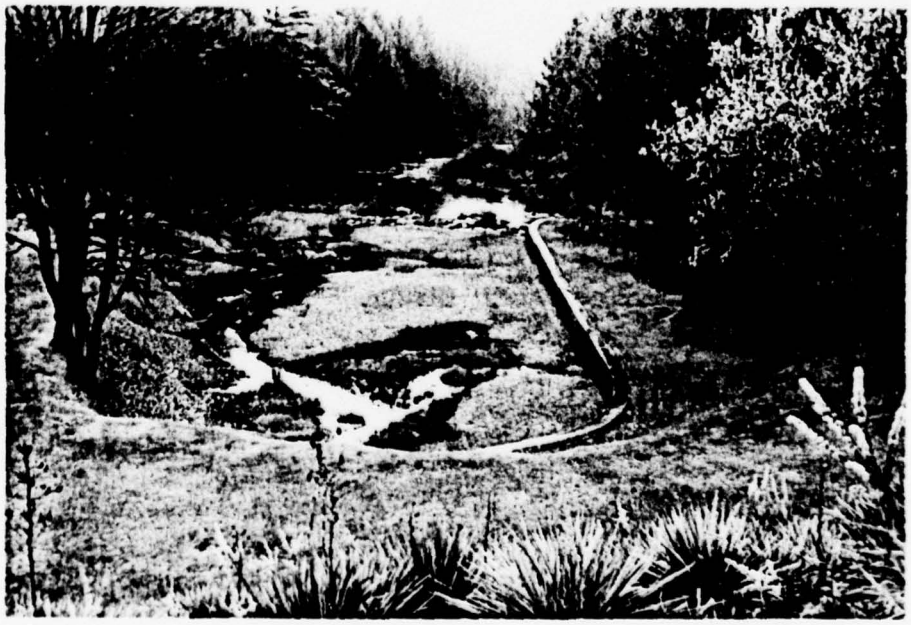


PHOTO 6. View Looking Downstream Along Outlet Pipe Discharge Channel

PHOTO 7. View of Downstream Embankment Showing Vegetation

PHOTO 8. View Looking at Crest and Upstream Slope

PHOTO 9. View Looking Downstream at Seepage Area

PHOTO 10. View of Seepage Through Sandstone Wall on Left Side of Ogee Spillway Channel

APPENDIX D

HYDROLOGIC AND HYDRAULIC COMPUTATIONS

MICHAEL BAKER, JR., INC.
THE BAKER ENGINEERS

Box 280
Beaver, Pa. 15009

Subject H.B. Norton Reservoir S.O. No. _____

Sheet No. _____ of _____

Drawing No. _____

Computed by _____ Checked by _____ Date _____

Table of Contents

MICHAEL BAKER, JR., INC.
THE BAKER ENGINEERS

Box 280
Beaver, Pa. 15009

Subject PA Dam Inspections — S.O. No. _____
Ridgway Reservoir — Sheet No. 1 of 24
Principal Spillway Rating — Drawing No. _____
Computed by REK — Checked by _____ — Date 12-14-78

H_o (design head) ≈ 2.0 feet L = 75.0 Feet

P = 3.0 ft $Q = CLH^{3/2}$

$P/H_o = 3.0/2.0 = 1.5$

$\frac{C_{Incl.}}{C_{Vert.}}$ = 0.98 (approx. value)

Elev (Ft)	Head (He) (ft)	H_e/H_o	C/C_o	C_o	$\frac{C_{Incl.}}{C_{Vert}}$	C	Q (cfs)
1415.0	0.0						0
1415.5	0.5	0.25	0.866	3.92	0.98	3.33	88
1416.0	1.0	0.50	0.920			3.53	265
1416.5	1.5	0.75	0.965			3.71	511
1417.0	2.0	1.00	1.000			3.84	815
1417.5	2.5	1.25	1.032			3.96	1174
1418.0	3.0	1.50	1.060			4.07	1586
1418.5	3.5	1.75	1.08			4.14	2033
1419.0	4.0	2.00					2484
1419.5	4.5	2.25					2964
1420.0	5.0	2.50					3471
1420.5	5.5	2.75					4005
1421.0	6.0	3.00					4563
1421.5	6.5	3.25					5146
1422.0	7.0	3.50					5751
1422.5	7.5	3.75					6378
1423.0	8.0	4.00					7026
1424.0	9.0	4.50					8384
1425.0	10.0	5.00					9819

MICHAEL BAKER, JR., INC.
THE BAKER ENGINEERS

Box 280
Beaver, Pa. 15009

Subject PA Dam Inspections — S.O. No.
Ridgway Reservoir — Sheet No. 2 of 21
Principal Spillway Rating — Drawing No.
Computed by REH — Checked by — Date 12-14-78

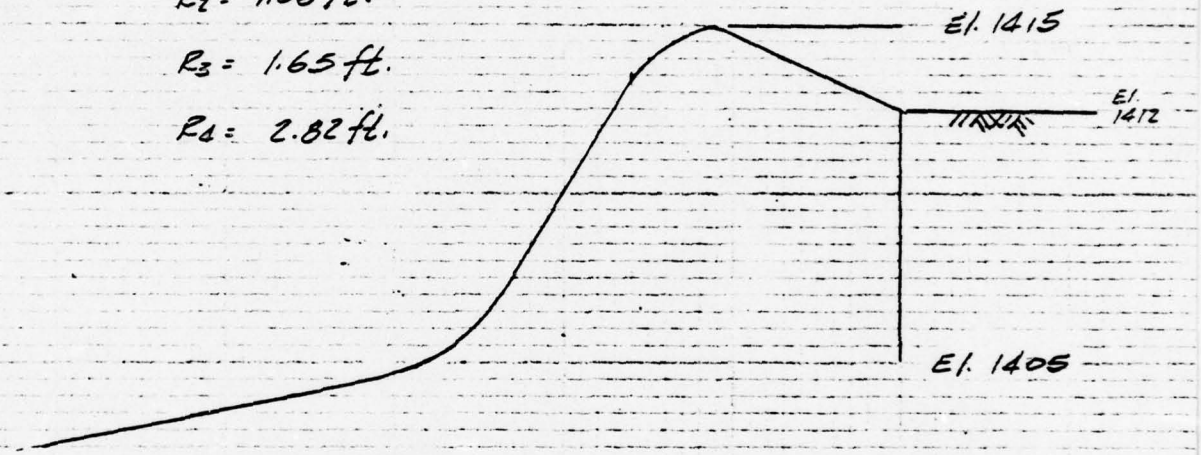
Design head = 2.0' (By D.S.D. - pg 377)

$R_1 = 0.47$ ft

$R_2 = 1.06$ ft.

$R_3 = 1.65$ ft.

$R_4 = 2.82$ ft.



Cross-section of Principal spillway

THIS RUN EXECUTED 01/04/79 10.36

```
**************************************************
  HEC2 RELEASE DATED NOV 76 UPDATED  AUG1977
  ERROR CORR -  01,02
  MODIFICATION -  50,51,52,53, MBJ UPDATE MADE 16 JAN 5 PM
**************************************************

T1      RIDGWAY RESERVOIR
T2      PENNSYLVANIA
T3      SPILLWAY RATING -EMERGENCY SPILLWAY

J1  ICHECK    INQ       NINV      IDIR      STRT      METRIC    HVINS     Q         WSEL      FQ
       0.       2.        0.        0. -1.000000       0.0       0.0       0.  1419.000       0.0

J2  NPROF     IPLOT     PRFVS     XSECV     XSECH     FN        ALLDC     IBW       CHNIM     ITRACE
    1.000       0.0    -1.000       0.0       0.0       0.0       0.0       0.0       0.0       0.0

J3  VARIABLE CODES FOR SUMMARY PRINTOUT
   38.000    43.000     1.000     8.000    39.000    65.000    53.000    27.000    21.000    22.000

   28.000    54.000     4.000     0.0      38.000    39.000    42.000    33.000    40.000    41.000

    1.000    50.000    51.000    52.000     3.000    61.000    64.000       0.0       0.0       0.0

NC      0.040     0.040     0.040       0.0       0.0       0.0       0.0       0.0       0.0       0.0
NC        0.0       0.0       0.0     0.100     0.300       0.0       0.0       0.0       0.0       0.0
QT      9.000   500.000  1000.000  2000.000  3000.000  4000.000  5000.000  6000.000  7000.000  8000.000

X1      4.000     4.000       0.0   150.000     9.000     9.000     9.000       0.0       0.0       0.0
GR   1428.000       0.0  1418.000       0.0  1418.000   150.000  1428.000   150.000       0.0       0.0

X1      5.000     4.000       0.0   150.000    11.000    11.000    11.000       0.0       0.0       0.0
GR   1430.000       0.0  1417.200       0.0  1416.200   150.000  1430.000   150.000       0.0       0.0

X1      6.000     5.000  -150.000   172.000   100.000   100.000   100.000       0.0       0.0       0.0
GR   1430.000  -150.000  1422.000  -150.000  1414.900       0.0  1414.900   150.000  1430.000   172.000

X1      7.000     5.000  -300.000   168.000   100.000   100.000   100.000       0.0       0.0       0.0
GR   1430.000  -300.000  1422.000  -300.000  1412.900       0.0  1412.900   150.000  1425.000   168.000
ES        0.0       0.0       0.0       0.0       0.0       0.0       0.0       0.0       0.0       0.0
```

34 of 34

THIS RUN EXECUTED 01/04/79 10.38

HEC2 RELEASE DATED NOV 76 UPDATED AUG1977
ERROR CORR - 01,02
MODIFICATION - 50,51,52,53, MBJ UPDATE MADE 16 JAN 5 PM

NOTE- ASTERISK (*) AT LEFT OF CROSS-SECTION NUMBER INDICATES MESSAGE IN SUMMARY OF ERRORS LIST

SPILLWAY RATING

SUMMARY PRINTOUT

	SECNO	Q	CWSEL	DEPTH	XLCH	CUM OLS	SSTA	STENCL	STCHL	STCHR	STENCR	ENDST	TOPWID
*	4.000	500.00	1418.70	0.70	9.00	0.0	0.0	0.0	0.0	150.00	0.0	150.00	150.00
*	4.000	1000.00	1419.11	1.11	9.00	0.0	0.0	0.0	0.0	150.00	0.0	150.00	150.00
*	4.000	2000.00	1419.76	1.76	9.00	0.0	0.0	0.0	0.0	150.00	0.0	150.00	150.00
*	4.000	3000.00	1420.31	2.31	9.00	0.0	0.0	0.0	0.0	150.00	0.0	150.00	150.00
*	4.000	4000.00	1420.80	2.80	9.00	0.0	0.0	0.0	0.0	150.00	0.0	150.00	150.00
*	4.000	5000.00	1421.25	3.25	9.00	0.0	0.0	0.0	0.0	150.00	0.0	150.00	150.00
*	4.000	6000.00	1421.66	3.66	9.00	0.0	0.0	0.0	0.0	150.00	0.0	150.00	150.00
*	4.000	7000.00	1422.07	4.07	9.00	0.0	0.0	0.0	0.0	150.00	0.0	150.00	150.00
*	4.000	8000.00	1422.44	4.44	9.00	0.0	0.0	0.0	0.0	150.00	0.0	150.00	150.00
	5.000	500.00	1419.07	2.87	11.00	11.00	0.0	0.0	0.0	150.00	0.0	150.00	150.00
	5.000	1000.00	1419.67	3.47	11.00	11.00	0.0	0.0	0.0	150.00	0.0	150.00	150.00
	5.000	2000.00	1420.58	4.38	11.00	11.00	0.0	0.0	0.0	150.00	0.0	150.00	150.00
	5.000	3000.00	1421.32	5.12	11.00	11.00	0.0	0.0	0.0	150.00	0.0	150.00	150.00
	5.000	4000.00	1421.96	5.76	11.00	11.00	0.0	0.0	0.0	150.00	0.0	150.00	150.00
	5.000	5000.00	1422.55	6.35	11.00	11.00	0.0	0.0	0.0	150.00	0.0	150.00	150.00
	5.000	6000.00	1423.09	6.89	11.00	11.00	0.0	0.0	0.0	150.00	0.0	150.00	150.00
	5.000	7000.00	1423.59	7.39	11.00	11.00	0.0	0.0	0.0	150.00	0.0	150.00	150.00
	5.000	8000.00	1424.07	7.87	11.00	11.00	0.0	0.0	0.0	150.00	0.0	150.00	150.00
	6.000	500.00	1419.11	4.21	100.00	111.00	-88.90	0.0	-150.00	172.00	0.0	156.13	245.03
	6.000	1000.00	1419.76	4.86	100.00	111.00	-102.71	0.0	-150.00	172.00	0.0	157.08	259.79
	6.000	2000.00	1420.79	5.89	100.00	111.00	-124.38	0.0	-150.00	172.00	0.0	158.58	282.95
	6.000	3000.00	1421.64	6.74	100.00	111.00	-142.36	0.0	-150.00	172.00	0.0	159.82	302.17
	6.000	4000.00	1422.39	7.49	100.00	111.00	-150.00	0.0	-150.00	172.00	0.0	160.91	310.91
	6.000	5000.00	1423.08	8.18	100.00	111.00	-150.00	0.0	-150.00	172.00	0.0	161.91	311.91
	6.000	6000.00	1423.72	8.82	100.00	111.00	-150.00	0.0	-150.00	172.00	0.0	162.84	312.84
	6.000	7000.00	1424.32	9.42	100.00	111.00	-150.00	0.0	-150.00	172.00	0.0	163.72	313.72
	6.000	8000.00	1424.89	9.99	100.00	111.00	-150.00	0.0	-150.00	172.00	0.0	164.56	314.56
	7.000	500.00	1419.11	6.22	100.00	211.00	-204.89	0.0	-300.00	168.00	0.0	159.25	364.14
	7.000	1000.00	1419.78	6.88	100.00	211.00	-226.79	0.0	-300.00	168.00	0.0	160.23	387.03
	7.000	2000.00	1420.83	7.93	100.00	211.00	-261.33	0.0	-300.00	168.00	0.0	161.79	423.12
	7.000	3000.00	1421.70	8.80	100.00	211.00	-289.99	0.0	-300.00	168.00	0.0	163.09	453.07
	7.000	4000.00	1422.47	9.57	100.00	211.00	-300.00	0.0	-300.00	168.00	0.0	164.23	464.23
	7.000	5000.00	1423.17	10.27	100.00	211.00	-300.00	0.0	-300.00	168.00	0.0	165.27	465.27
	7.000	6000.00	1423.82	10.92	100.00	211.00	-300.00	0.0	-300.00	168.00	0.0	166.25	466.25
	7.000	7000.00	1424.44	11.54	100.00	211.00	-300.00	0.0	-300.00	168.00	0.0	167.16	467.16
	7.000	8000.00	1425.02	12.12	100.00	211.00	-300.00	0.0	-300.00	168.00	0.0	168.00	468.00

4 of 4

SPILLWAY RATING

SUMMARY PRINTOUT

	SECNO	VLCH	ELMIN	K*CHSL	FLTRD	ELLC	CWSEL	DIFWSP	DIFWSX	DIFKWS	EG	DIFEG	INPUT ET
*	4.000	9.00	1418.00	0.0	0.0	0.0	1418.70	0.0	0.0	-0.30	1419.05	0.0	0.0
*	4.000	9.00	1418.00	0.0	0.0	0.0	1419.11	0.41	0.0	0.11	1419.67	0.62	0.0
*	4.000	9.00	1418.00	0.0	0.0	0.0	1419.76	0.65	0.0	-0.24	1420.65	1.60	0.0
*	4.000	9.00	1418.00	0.0	0.0	0.0	1420.31	0.55	0.0	0.31	1421.47	2.42	0.0
*	4.000	9.00	1418.00	0.0	0.0	0.0	1420.80	0.48	0.0	-0.20	1422.21	3.16	0.0
*	4.000	9.00	1418.00	0.0	0.0	0.0	1421.25	0.45	0.0	0.25	1422.88	3.83	0.0
*	4.000	9.00	1418.00	0.0	0.0	0.0	1421.66	0.42	0.0	-0.34	1423.51	4.46	0.0
*	4.000	9.00	1418.00	0.0	0.0	0.0	1422.07	0.41	0.0	0.07	1424.11	5.06	0.0
*	4.000	9.00	1418.00	0.0	0.0	0.0	1422.44	0.37	0.0	0.44	1424.68	5.63	0.0
	5.000	11.00	1416.20	-163.66	0.0	0.0	1419.07	0.0	0.37	0.0	1419.10	0.0	0.0
	5.000	11.00	1416.20	-163.66	0.0	0.0	1419.67	0.60	0.96	0.0	1419.75	0.65	0.0
	5.000	11.00	1416.20	-163.66	0.0	0.0	1420.58	0.91	0.82	0.0	1420.76	1.66	0.0
	5.000	11.00	1416.20	-163.66	0.0	0.0	1421.32	0.74	1.00	0.0	1421.61	2.51	0.0
	5.000	11.00	1416.20	-163.66	0.0	0.0	1421.96	0.65	1.17	0.0	1422.36	3.26	0.0
	5.000	11.00	1416.20	-163.66	0.0	0.0	1422.55	0.58	1.30	0.0	1423.05	3.95	0.0
	5.000	11.00	1416.20	-163.66	0.0	0.0	1423.09	0.54	1.43	0.0	1423.70	4.60	0.0
	5.000	11.00	1416.20	-163.66	0.0	0.0	1423.59	0.50	1.52	0.0	1424.31	5.21	0.0
	5.000	11.00	1416.20	-163.66	0.0	0.0	1424.07	0.48	1.63	0.0	1424.89	5.79	0.0
	6.000	100.00	1414.90	-13.00	0.0	0.0	1419.11	0.0	0.04	0.0	1419.11	0.0	0.0
	6.000	100.00	1414.90	-13.00	0.0	0.0	1419.76	0.65	0.09	0.0	1419.78	0.66	0.0
	6.000	100.00	1414.90	-13.00	0.0	0.0	1420.79	1.03	0.21	0.0	1420.83	1.71	0.0
	6.000	100.00	1414.90	-13.00	0.0	0.0	1421.64	0.85	0.32	0.0	1421.70	2.58	0.0
	6.000	100.00	1414.90	-13.00	0.0	0.0	1422.39	0.75	0.43	0.0	1422.47	3.36	0.0
	6.000	100.00	1414.90	-13.00	0.0	0.0	1423.08	0.69	0.53	0.0	1423.18	4.06	0.0
	6.000	100.00	1414.90	-13.00	0.0	0.0	1423.72	0.64	0.63	0.0	1423.83	4.72	0.0
	6.000	100.00	1414.90	-13.00	0.0	0.0	1424.32	0.60	0.73	0.0	1424.45	5.34	0.0
	6.000	100.00	1414.90	-13.00	0.0	0.0	1424.89	0.57	0.82	0.0	1425.05	5.93	0.0
	7.000	100.00	1412.90	-20.00	0.0	0.0	1419.11	0.0	0.01	0.0	1419.12	0.0	0.0
	7.000	100.00	1412.90	-20.00	0.0	0.0	1419.78	0.66	0.02	0.0	1419.78	0.67	0.0
	7.000	100.00	1412.90	-20.00	0.0	0.0	1420.83	1.05	0.04	0.0	1420.84	1.72	0.0
	7.000	100.00	1412.90	-20.00	0.0	0.0	1421.70	0.87	0.06	0.0	1421.72	2.60	0.0
	7.000	100.00	1412.90	-20.00	0.0	0.0	1422.47	0.77	0.08	0.0	1422.49	3.38	0.0
	7.000	100.00	1412.90	-20.00	0.0	0.0	1423.17	0.70	0.09	0.0	1423.20	4.09	0.0
	7.000	100.00	1412.90	-20.00	0.0	0.0	1423.82	0.65	0.11	0.0	1423.86	4.75	0.0
	7.000	100.00	1412.90	-20.00	0.0	0.0	1424.44	0.61	0.12	0.0	1424.49	5.37	0.0
	7.000	100.00	1412.90	-20.00	0.0	0.0	1425.02	0.59	0.13	0.0	1425.08	5.96	0.0

SUMMARY OF ERRORS

CAUTION SECNO= 4.000 PROFILE= 1 CRITICAL DEPTH ASSUMED
CAUTION SECNO= 4.000 PROFILE= 2 CRITICAL DEPTH ASSUMED
CAUTION SECNO= 4.000 PROFILE= 3 CRITICAL DEPTH ASSUMED
CAUTION SECNO= 4.000 PROFILE= 4 CRITICAL DEPTH ASSUMED
CAUTION SECNO= 4.000 PROFILE= 5 CRITICAL DEPTH ASSUMED
CAUTION SECNO= 4.000 PROFILE= 6 CRITICAL DEPTH ASSUMED
CAUTION SECNO= 4.000 PROFILE= 7 CRITICAL DEPTH ASSUMED
CAUTION SECNO= 4.000 PROFILE= 8 CRITICAL DEPTH ASSUMED
CAUTION SECNO= 4.000 PROFILE= 9 CRITICAL DEPTH ASSUMED

42 of 45

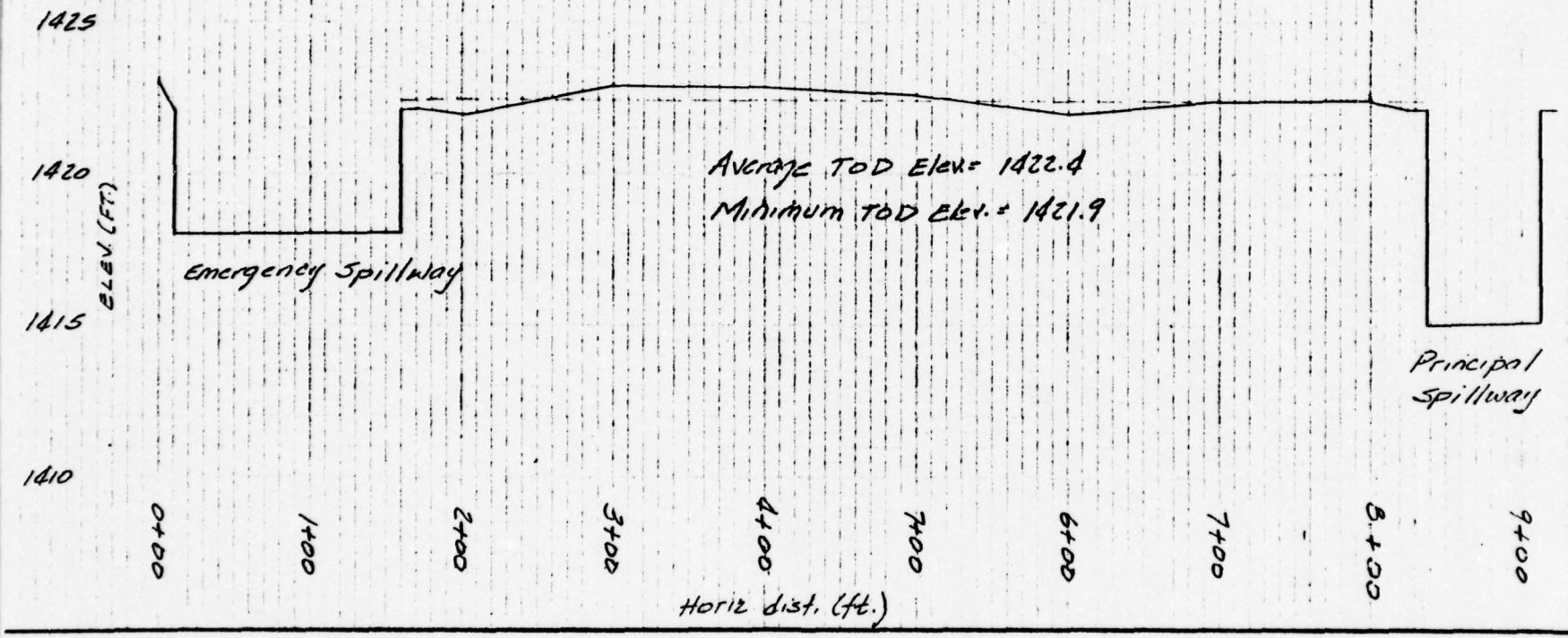
MICHAEL BAKER, JR., INC.
THE BAKER ENGINEERS

Box 280
Beaver, Pa. 15009

Subject Pa no name 42
Stage vs. Discharge
S.O. No.
Sheet No. 6 of 24
Drawing No.
Computed by REH & SCB Checked by Date 1/5/79

Elev. (feet)	Principal Spillway Flow (cfs.)	EMS Flow (cfs.)	TOTAL FLOW (cfs.)
1415.0	0		0
1415.5	88		88.
1416.0	265		265.
1416.5	511		511.
1417.0	815		815.
1417.5	1174		1174.
1418.0	1586	0	1586.
1418.5	2033	170.	2203.
1419.0	2484	430.	2914.
1419.5	2964	770.	3734.
1420.0	3471	1200.	4671.
1420.5	4005	1660.	5665.
1421.0	4563	2170.	6733.
1421.5	5146	2740.	7886.
1422.0	5751	3360.	9111.
1422.5	6378	4000.	10,378.
1423.0	7026	4700.	11,726.
1423.5		5450.	
1424.0	8384	6230.	14,614.
1424.5		7000.	
1425.0	9819	7880.	17,699.

PA. No Name No. 42
Top of Dam Profile
(looking downstream)
REH 11-27-78



Sheet 7 of 24

MICHAEL BAKER, JR., INC.
THE BAKER ENGINEERS

Box 280
Beaver, Pa. 15009

Subject PA Non-Federal Dam Insp. S.O. No.
PA-No Name 42 Sheet No. 8 of 24
Ridgeway Reservoir - T_c Drawing No.
Computed by DJG Checked by Date 1/6/79

Max. Elev. Watershed 2100 ft
Res. Elev. 1434 ft

$$\text{Avg. Slope} = \frac{2100 - 1434}{78{,}200} = 0.0085 \text{ ft/ft}$$

Velocity = 2.0 ft/sec

$$T_c = 78{,}200 / 2.0 \times \frac{1}{60} = 651.7 \text{ min} = 10 \text{ hrs } 52 \text{ min}$$

Data From Corps of Engineers

Zone 24 $\Rightarrow C_p = 0.45$ & Plate M

$$(L L_{CA}) = \frac{78{,}200}{5280} \times \frac{41{,}000}{5280} = 115.00$$

$$t_p = 1.6 (115.0)^{0.3} = 6.64 \text{ hours}$$

Duration = Use 0.25 hour

$$t_{pR} = 6.64 + 0.25 (0.25 - \frac{6.64}{53}) = 6.40 \text{ hours}$$

MICHAEL BAKER, JR., INC.
THE BAKER ENGINEERS

Box 280
Beaver, Pa. 15009

Subject PA Non Federal Dam Inspection S.O. No. _____
PA - No Name 42 : Ridgeway Res. Sheet No. 9 of 24
Storage Computations Drawing No. _____
Computed by DJG Checked by _____ Date 1/6/79

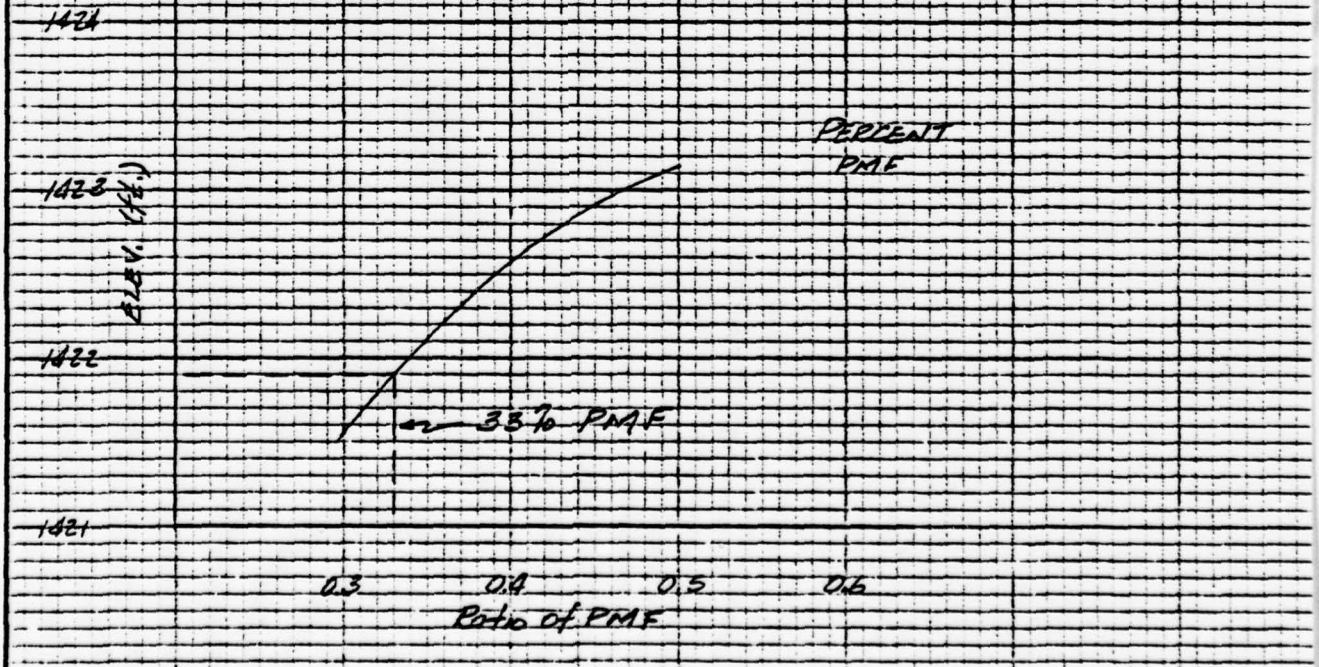
Elev.	Area In²	Area Acres	Volume Ac-ft
1415.0	30.91	76.03	617.
1420.0	39.62	99.05	

$\Delta E = \frac{5(617)}{76} = 29.36$

Elev = 1415.0 + 29.36 = 1590.64

Overtopping Analysis

Weir Coeff for sloping face Broad crested ≤ 3.08
Ref: Kingt Brater (Handbook of Hydraulics) (Critical Depth)



BREACH PARAMETERS

EARTH DAM $\frac{HD}{2} \leq BRWID \leq 3\ HD$

TRAPEZOIDAL FAILURE ASSUMED

TOP - TOE = 1422.4 - 1396.8 = 25.6 ft = HD

13' ≤ BRWID ≤ 75'

Assume 75' WIDTH & Z = 0.5

Assume Failure Time ≈ 1 hour HIGHLY EROSIVE MATL.

Assume Failure occurs at 1.0 ft above dam Elev. 1422.9 say

Assume Failure stops at elev. 1397

NOTE: HEC-1 Time Intervals = 1 hour which is to long for the dam break (see HEC-1 Dam Break User Manual pg 12, 3/78)

Use Time Interval = 0.25 HR = 15 min

This changes $T_p = 6.64 + \frac{\left(0.25 - \frac{6.64}{5.5}\right)}{4} = 6.40$ hrs

No downstream routing is required since the damage area is at the base of the dam only

```
**********
FLOOD HYDROGRAPH PACKAGE (HEC-1)
DAM SAFETY VERSION       JULY 1978
  LAST MODIFICATION  25 SEP 78
**********
     1                 A1       NATIONAL PROGRAM FOR INSPECTION OF NON-FEDERAL DAMS
     2                 A2       HYDROLOGIC AND HYDRAULIC ANALYSIS OF PA NO NAME  42 MRJ  25
     3                 A3       PROBABLE MAXIMUM FLOOD PMF/UNIT GRAPH BY SNYDERS METHOD
     4                 B    250       0      15       0       0       0       0       0      -4       0
     5                 B1     5
     6                 J      1       4       1
     7                 J1   1.0     0.5     0.4     0.3
     8                 K              RES                                             1
     9                 K1       THIS IS THE INFLOW HYDROGRAPH FOR THE RIDGEWAY RESERVOIR
    10                 M      1       1    30.1                                                   1
    11                 P             23.0     103     113     126     136
    12                 T                                                     1.0    0.05
    13                 W   6.40    0.45
    14                 Y   -1.5   -0.05     2.0
    15                 K      1     DAM                                             1
    16                 K1       THIS IS THE ROUTING AT THE RIDGEWAY RESERVOIR - PLAN DATUM USED
    17                 Y                                      1       1
    18                 Y1     1                                                -1415      -1
    19                 Y4  1415  1415.5    1416  1416.5    1417  1417.5    1418  1418.5    1419  1419.5
    20                 Y4  1420  1420.5    1421  1421.5    1422  1422.5    1423    1424    1425
    21                 Y5            88     265     511     815    1174    1586    2203    2914    3734
    22                 Y5  4671    5665    6733    7886    9111   10379   11726   14614   17699
    23                 $A            75.9      99
    24                 $E1390.6    1415    1420
    25                 $$  1415
    26                 $D1422.4    3.08     1.5     678
    27                 K     99
```

11 of 24

****
FLOOD HYDROGRAPH PACKAGE (HEC-1)
DAM SAFETY VERSION JULY 1978
LAST MODIFICATION 25 SEP 78
****

RUN DATE 02/08/79
TIME 08.32

NATIONAL PROGRAM FOR INSPECTION OF NON-FEDERAL DAMS
HYDROLOGIC AND HYDRAULIC ANALYSIS OF PA NO NAME 42 MAJ 25
PROBABLE MAXIMUM FLOOD PMF/UNIT GRAPH BY SNYDERS METHOD

JOB SPECIFICATION

NQ	NHR	NMIN	IDAY	IHR	IMIN	METRC	IPLT	IPRT	NSTAN
250	0	15	0	0	0	0	0	-4	0

JOPER	NWT	LROPT	TRACE
5	0	0	0

MULTI-PLAN ANALYSES TO BE PERFORMED
NPLAN= 1 NRTIO= 4 LRTIO= 1
RTIOS= 1.00 0.50 0.40 0.30

********** ********** ********** ********** **********

SUB-AREA RUNOFF COMPUTATION

THIS IS THE INFLOW HYDROGRAPH FOR THE RIDGEWAY RESERVOIR

ISTAQ	ICOMP	IECON	ITAPE	JPLT	JPRT	INAME	ISTAGE	IAUTO
RES	0	0	0	0	0	1	0	0

HYDROGRAPH DATA

IHYDG	IUHG	TAREA	SNAP	TRSDA	TRSPC	RATIO	ISNOW	ISAME	LOCAL
1	1	30.10	0.0	30.10	0.0	0.0	0	1	0

PRECIP DATA

SPFE	PMS	R6	R12	R24	R48	R72	R96
0.0	23.00	103.00	113.00	126.00	136.00	0.0	0.0

TRSPC COMPUTED BY THE PROGRAM IS 0.835

LOSS DATA

LROPT	STRKR	DLTKR	RTIOL	ERAIN	STRKS	RTIOK	STRTL	CNSTL	ALSMX	RTIMP
0	0.0	0.0	1.00	0.0	0.0	1.00	1.00	0.05	0.0	0.0

UNIT HYDROGRAPH DATA
TP= 6.40 CP=0.45 NTA= 0

RECESSION DATA
STRTQ= -1.50 QRCSN= -0.05 RTIOR= 2.00

UNIT HYDROGRAPH100 END-OF-PERIOD ORDINATES, LAG= 6.41 HOURS, CP= 0.45 VOL= 0.88

10.	38.	79.	129.	185.	248.	315.	387.	462.	541.
623.	707.	794.	880.	963.	1039.	1109.	1172.	1229.	1279.
1321.	1357.	1384.	1402.	1411.	1406.	1382.	1349.	1316.	1285.
1254.	1223.	1194.	1165.	1137.	1109.	1082.	1056.	1031.	1006.
981.	958.	935.	912.	890.	868.	847.	827.	807.	787.

12 of 24

768.	750.	732.	714.	697.	680.	663.	647.	632.	617.
602.	587.	573.	559.	546.	532.	519.	507.	495.	483.
471.	460.	449.	438.	427.	417.	407.	397.	387.	378.
369.	360.	351.	343.	334.	326.	318.	311.	303.	296.
289.	282.	275.	268.	262.	255.	249.	243.	237.	232.

0 MO.DA	HR.MN	PERIOD	RAIN	EXCS	LOSS	END-OF-PERIOD FLOW COMP Q	MO.DA	HR.MN	PERIOD	RAIN	EXCS	LOSS	COMP Q
									SUM	26.13	23.69	2.44	1571923.
										(664.)	(602.)	(62.)	(44511.97)

********** *********** ********** ********* **********

HYDROGRAPH ROUTING

THIS IS THE ROUTING AT THE RIDGEWAY RESERVOIR - PLAN DATUM USED

ISTAQ	ICOMP	IECON	ITAPE	JPLT	JPRT	INAME	ISTAGE	IAUTO
DAM	1	0	0	0	0	1	0	0

ROUTING DATA

QLOSS	CLOSS	AVG	IRES	ISAME	IOPT	IPMP	LSTR
0.0	0.0	0.0	1	1	0	0	0

NSTPS	NSTDL	LAG	AMSKK	X	TSK	STORA	ISPRAT
1	0	0	0.0	0.0	0.0	-1415.	-1

STAGE	1415.00	1415.50	1416.00	1416.50	1417.00	1417.50	1418.00	1418.50	1419.00	1419.50
	1420.00	1420.50	1421.00	1421.50	1422.00	1422.50	1423.00	1424.00	1425.00	
FLOW	0.0	88.00	265.00	511.00	815.00	1174.00	1586.00	2203.00	2914.00	3734.00
	4671.00	5665.00	6733.00	7886.00	9111.00	10378.00	11726.00	14614.00	17699.00	
SURFACE AREA=	0.	76.	99.							
CAPACITY=	0.	617.	1053.							
ELEVATION=	1391.	1415.	1420.							

CREL	SPWID	COQW	EXPW	ELEVL	COQL	CAREA	EXPL
1415.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

DAM DATA

TOPEL	COQD	EXPD	DAMWID
1422.4	3.1	1.5	678.

WARNING *** TOP OF DAM, BOTTOM OF BREACH, OR LOW-LEVEL OUTLET IS NOT WITHIN RANGE OF GIVEN ELEVATIONS IN STORAGE-ELEVATION DATA
BOTTOM OF RESERVOIR ASSUMED TO BE AT 1390.60
STORAGE-ELEVATION DATA WILL BE EXTRAPOLATED ABOVE ELEVATION 1420.00

PEAK OUTFLOW IS 26986. AT TIME 46.00 HOURS

WARNING *** TOP OF DAM, BOTTOM OF BREACH, OR LOW-LEVEL OUTLET IS NOT WITHIN RANGE OF GIVEN ELEVATIONS IN STORAGE-ELEVATION DATA
BOTTOM OF RESERVOIR ASSUMED TO BE AT 1390.60
STORAGE-ELEVATION DATA WILL BE EXTRAPOLATED ABOVE ELEVATION 1420.00

PEAK OUTFLOW IS 13480. AT TIME 46.00 HOURS

WARNING *** TOP OF DAM, BOTTOM OF BREACH, OR LOW-LEVEL OUTLET IS NOT WITHIN RANGE OF GIVEN ELEVATIONS IN STORAGE-ELEVATION DATA

BOTTOM OF RESERVOIR ASSUMED TO BE AT 1390.60
STORAGE-ELEVATION DATA WILL BE EXTRAPOLATED ABOVE ELEVATION 1420.00

PEAK OUTFLOW IS 10744. AT TIME 46.25 HOURS

WARNING *** TOP OF DAM, BOTTOM OF BREACH, OR LOW-LEVEL OUTLET IS NOT WITHIN RANGE OF GIVEN ELEVATIONS IN STORAGE-ELEVATION DATA
BOTTOM OF RESERVOIR ASSUMED TO BE AT 1390.60
STORAGE-ELEVATION DATA WILL BE EXTRAPOLATED ABOVE ELEVATION 1420.00

PEAK OUTFLOW IS 8020. AT TIME 46.25 HOURS

********** ********** ********** ********** **********

PEAK FLOW AND STORAGE (END OF PERIOD) SUMMARY FOR MULTIPLE PLAN-RATIO ECONOMIC COMPUTATIONS
FLOWS IN CUBIC FEET PER SECOND (CUBIC METERS PER SECOND)
AREA IN SQUARE MILES (SQUARE KILOMETERS)

OPERATION	STATION	AREA	PLAN	RATIOS APPLIED TO FLOWS RATIO 1 1.00	RATIO 2 0.50	RATIO 3 0.40	RATIO 4 0.30
HYDROGRAPH AT	RES	30.10	1	27024.	13512.	10810.	8107.
		(77.96)		(765.25)(	382.62)(	306.10)(	229.57)(
ROUTED TO	DAM	30.10	1	26986.	13480.	10744.	8020.
		(77.96)		(764.16)(	381.70)(	304.23)(	227.10)(

SUMMARY OF DAM SAFETY ANALYSIS

PLAN 1 .....

		AVERAGE TOP OF DAM	MINIMUM TOP OF DAM
ELEVATION	INITIAL VALUE 1415.00	SPILLWAY CREST 1415.00	1422.40	1421.90
STORAGE	617.	617.	1305.	
OUTFLOW	0.	0.	10124.	

RATIO OF PMF	MAXIMUM RESERVOIR W.S.ELEV	AVERAGE ~~MAXIMUM~~ DEPTH OVER DAM	MAXIMUM DEPTH	MAXIMUM STORAGE AC-FT	MAXIMUM OUTFLOW CFS	DURATION OVER TOP HOURS	TIME OF MAX OUTFLOW HOURS	TIME OF FAILURE HOURS
1.00	1425.07	2.67	3.17	1621.	26986.	16.25	46.00	0.0
0.50	1423.14	0.74	1.24	1389.	13480.	6.75	46.00	0.0
0.40	1422.58	0.18	0.68	1325.	10744.	2.50	46.25	0.0
0.30	1421.55	0.0	0.00	1213.	8020.	0.0	46.25	0.0

16 of 24

```
**********
FLOOD HYDROGRAPH PACKAGE (HEC-1)
DAM SAFETY VERSION     JULY 1978
  LAST MODIFICATION  25 SEP 78
**********
    1              AI      NATIONAL PROGRAM FOR INSPECTION OF NON-FEDERAL DAMS
    2              A2      HYDROLOGIC AND HYDRAULIC ANALYSIS OF PA NO NAME  42 MBJ  25
    3              A3   .5 PROBABLE MAXIMUM FLOOD PMF/UNIT GRAPH BY SNYDERS METHOD
    4              B    250       0      15       0       0       0       0       0      -4       0
    5              B1     5
    6              J      2       1       1
    7              J1   0.5
    8              K                RES                                     1
    9              K1       THIS IS THE INFLOW HYDROGRAPH FOR THE RIDGEWAY RESERVOIR
   10              M      1       1    30.1                                                    1
   11              P             23.0     103     113     126     136
   12              T                                                      1.0    0.05
   13              W   6.40    0.45
   14              Y   -1.5   -0.05     2.0
   15              K      1     DAM                                       1
   16              K1       THIS IS THE ROUTING AT THE RIDGEWAY RESERVOIR - PLAN DATUM USED
   17              Y                                1       1
   18              Y1     1                                               -1415      -1
   19              Y4  1415  1415.5    1416  1416.5    1417  1417.5    1418  1418.5    1419  1419.5
   20              Y4  1420  1420.5    1421  1421.5    1422  1422.5    1423    1424    1425
   21              Y5              88     265     511     815    1174    1586    2203    2914    3734
   22              Y5  4671    5665    6733    7886    9111   10378   11726   14614   17699
   23              $A            75.9      99
   24              $E1390.6      1415    1420
   25              $$  1415
   26              $D1422.4      3.08     1.5     678
   27              $B   100       .5    1397       1    1415  1422.9
   28              $B   100       .5    1357       1    1415  1424.0
   29              K     99
```

```
**********
FLOOD HYDROGRAPH PACKAGE (HEC-1)
DAM SAFETY VERSION     JULY 1978
  LAST MODIFICATION  25 SEP 78
**********

RUN  DATE 02/07/79
     TIME    18.05


                    NATIONAL PROGRAM FOR INSPECTION OF NON-FEDERAL DAMS
                    HYDROLOGIC AND HYDRAULIC ANALYSIS OF PA NO NAME  42 MBJ  25
                  .5 PROBABLE MAXIMUM FLOOD PMF/UNIT GRAPH BY SNYDERS METHOD

                                        JOB SPECIFICATION
          NQ      NHR     NMIN     IDAY      IHR     IMIN    METRC     IPLT     IPRT    NSTAN
         250        0       15        0        0        0        0        0       -4        0
                                   JOPER      NRT   LROPT    TRACE
                                       5        0        0        0

                                  MULTI-PLAN ANALYSES TO BE PERFORMED
                                    NPLAN= 2 NRTIO= 1 LRTIO= 1
                    RTIOS=   0.50

**********      **********      **********      **********      **********
                                  SUB-AREA RUNOFF COMPUTATION
                    THIS IS THE INFLOW HYDROGRAPH FOR THE RIDGEWAY RESERVOIR
                                ISTAQ   ICOMP   IECON   ITAPE    JPLT    JPRT   INAME  ISTAGE   IAUTO
                                  RES       0       0       0       0       0       1       0       0
                                                HYDROGRAPH DATA
              IHYDG    IUHG   TAREA    SNAP   TRSDA   TRSPC   RATIO   ISNOW   ISAME   LOCAL
                  1       1   30.10     0.0   30.10     0.0     0.0       0       1       0
                                                PRECIP DATA
                          SPFE     PMS      R6     R12     R24     R48     R72     R96
                           0.0   23.00  103.00  113.00  126.00  136.00     0.0     0.0
TRSPC COMPUTED BY THE PROGRAM IS 0.835
                                                LOSS DATA
          LROPT   STRKR   DLTKR   RTIOL   ERAIN   STRKS   RTIOK   STRTL   CNSTL   ALSMX   RTIMP
              0     0.0     0.0    1.00     0.0     0.0    1.00    1.00    0.05     0.0     0.0
                                            UNIT HYDROGRAPH DATA
                                      TP=  6.40    CP=0.45    NTA=  0
                                            RECESSION DATA
                                   STRTQ=   -1.50    QRCSN=   -0.05    RTIOR= 2.00
                UNIT HYDROGRAPH100 END-OF-PERIOD ORDINATES, LAG=   6.41 HOURS, CP= 0.45  VOL= 0.88
          10.     38.     79.    129.    185.    248.    315.    387.    462.    541.
         623.    707.    794.    880.    963.   1039.   1109.   1172.   1229.   1279.
        1321.   1357.   1384.   1402.   1411.   1406.   1382.   1349.   1316.   1285.
        1254.   1223.   1194.   1165.   1137.   1109.   1082.   1056.   1031.   1006.
         981.    958.    935.    912.    890.    868.    847.    827.    807.    787.
```

768.	750.	732.	714.	697.	680.	663.	647.	632.	617.
602.	587.	573.	559.	546.	532.	519.	507.	495.	483.
471.	460.	449.	438.	427.	417.	407.	397.	387.	378.
369.	360.	351.	343.	334.	326.	318.	311.	303.	296.
289.	282.	275.	268.	262.	255.	249.	243.	237.	232.

0 END-OF-PERIOD FLOW

MO.DA	HR.MN	PERIOD	RAIN	EXCS	LOSS	COMP Q	MO.DA	HR.MN	PERIOD	RAIN	EXCS	LOSS	COMP Q
									SUM	26.13	23.69	2.44	1571923.
										(669.)(602.)(62.)(44511.97)			

********** ********** ********** ********** **********

HYDROGRAPH ROUTING

THIS IS THE ROUTING AT THE RIDGEWAY RESERVOIR - PLAN DATUM USED

ISTAQ	ICOMP	IECON	ITAPE	JPLT	JPRT	INAME	ISTAGE	IAUTO
DAM	1	0	0	0	0	1	0	0

ALL PLANS HAVE SAME ROUTING DATA

QLOSS	CLOSS	AVG	IRES	ISAME	IOPT	IPMP	LSTR
0.0	0.0	0.0	1	1	0	0	0

NSTPS	NSTDL	LAG	AMSKK	X	TSK	STORA	ISPRAT
1	0	0	0.0	0.0	0.0	-1415.	-1

STAGE	1415.00	1415.50	1416.00	1416.50	1417.00	1417.50	1418.00	1418.50	1419.00	1419.50
	1420.00	1420.50	1421.00	1421.50	1422.00	1422.50	1423.00	1424.00	1425.00	
FLOW	0.0	88.00	265.00	511.00	815.00	1174.00	1586.00	2203.00	2914.00	3734.00
	4671.00	5865.00	6733.00	7886.00	9111.00	10378.00	11726.00	14614.00	17699.00	
SURFACE APEA=	0.	76.	99.							
CAPACITY=	0.	617.	1053.							
ELEVATION=	1391.	1419.	1420.							

CREL	SPWID	COQW	EXPW	ELEVL	COQL	CAREA	EXPL
1415.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

DAM DATA

TOPEL	COQD	EXPD	DAMWID
1422.4	3.1	1.5	678.

DAM BREACH DATA

BRWID	Z	ELBM	IFAIL	WSEL	FAILEL
100.	0.50	1397.00	1.00	1415.00	1422.90

WARNING *** TOP OF DAM, BOTTOM OF BREACH, OR LOW-LEVEL OUTLET IS NOT WITHIN RANGE OF GIVEN ELEVATIONS IN STORAGE-ELEVATION DATA
BOTTOM OF RESERVOIR ASSUMED TO BE AT 1390.60
STORAGE-ELEVATION DATA WILL BE EXTRAPOLATED ABOVE ELEVATION 1420.00

BEGIN DAM FAILURE AT 44.50 HOURS

PEAK OUTFLOW IS 28841. AT TIME 45.50 HOURS

THE DAM BREACH HYDROGRAPH WAS DEVELOPED USING A TIME INTERVAL OF 0.019 HOURS DURING BREACH FORMATION.
DOWNSTREAM CALCULATIONS WILL USE A TIME INTERVAL OF 0.250 HOURS.
THIS TABLE COMPARES THE HYDROGRAPH FOR DOWNSTREAM CALCULATIONS WITH THE COMPUTED BREACH HYDROGRAPH.
INTERMEDIATE FLOWS ARE INTERPOLATED FROM END-OF-PERIOD VALUES.

TIME (HOURS)	TIME FROM BEGINNING OF BREACH (HOURS)	INTERPOLATED BREACH HYDROGRAPH (CFS)	- COMPUTED BREACH HYDROGRAPH (CFS)	= ERROR (CFS)	ACCUMULATED ERROR (CFS)	ACCUMULATED ERROR (AC-FT)
44.500	0.0	12330.	12330.	0.	0.	0.
44.519	0.019	12648.	12665.	-17.	-17.	-0.
44.538	0.038	12966.	12920.	46.	29.	0.
44.558	0.058	13284.	13202.	83.	111.	0.
44.577	0.077	13602.	13502.	100.	212.	0.
44.596	0.096	13920.	13815.	106.	317.	1.
44.615	0.115	14239.	14136.	102.	420.	1.
44.635	0.135	14557.	14464.	93.	513.	1.
44.654	0.154	14875.	14795.	80.	593.	1.
44.673	0.173	15193.	15127.	66.	659.	1.
44.692	0.192	15511.	15461.	50.	708.	1.
44.712	0.212	15829.	15796.	33.	741.	1.
44.731	0.231	16147.	16130.	17.	759.	1.
44.750	0.250	16465.	16465.	0.	759.	1.
44.769	0.269	16837.	16802.	34.	793.	1.
44.788	0.288	17208.	17142.	65.	859.	1.
44.808	0.308	17579.	17490.	89.	948.	2.
44.827	0.327	17950.	17861.	90.	1037.	2.
44.846	0.346	18321.	18266.	55.	1093.	2.
44.865	0.365	18692.	18673.	19.	1112.	2.
44.885	0.385	19064.	19073.	-9.	1103.	2.
44.904	0.404	19435.	19463.	-28.	1075.	2.
44.923	0.423	19806.	19843.	-37.	1037.	2.
44.942	0.442	20177.	20221.	-43.	994.	2.
44.962	0.462	20548.	20589.	-40.	954.	2.
44.981	0.481	20920.	20945.	-26.	928.	1.
45.000	0.500	21291.	21291.	0.	928.	1.
45.019	0.519	21590.	21630.	-41.	887.	1.
45.038	0.538	21889.	21970.	-81.	806.	1.
45.058	0.558	22188.	22296.	-108.	699.	1.
45.077	0.577	22488.	22609.	-122.	577.	1.
45.096	0.596	22787.	22924.	-138.	440.	1.
45.115	0.615	23086.	23235.	-149.	291.	0.
45.135	0.635	23385.	23531.	-146.	144.	0.
45.154	0.654	23684.	23823.	-138.	6.	0.
45.173	0.673	23984.	24115.	-132.	-126.	-0.
45.192	0.692	24283.	24393.	-110.	-235.	-0.
45.212	0.712	24582.	24663.	-81.	-316.	-1.
45.231	0.731	24881.	24929.	-48.	-364.	-1.
45.250	0.750	25180.	25180.	0.	-364.	-1.
45.269	0.769	25462.	25450.	12.	-352.	-1.
45.288	0.788	25744.	25712.	32.	-320.	-1.
45.308	0.808	26025.	25971.	54.	-266.	-0.
45.327	0.827	26307.	26243.	64.	-202.	-0.
45.346	0.846	26588.	26497.	92.	-110.	-0.
45.365	0.865	26870.	26773.	97.	-13.	-0.
45.385	0.885	27152.	27029.	123.	110.	0.
45.404	0.904	27433.	27351.	82.	192.	0.
45.423	0.923	27715.	27662.	53.	246.	0.
45.442	0.942	27997.	27973.	25.	269.	0.
45.462	0.962	28278.	28265.	13.	282.	0.
45.481	0.981	28560.	28561.	-1.	281.	0.

45.500 1.000 28841. 28841. 0. 281. 0.

OVF

STATION DAM

TIME (HRS) (O) INTERPOLATED BREACH HYDROGRAPH (B) COMPUTED BREACH HYDROGRAPH (*) POINTS AT NORMAL TIME INTERVAL

12000. 14000. 16000. 18000. 20000. 22000. 24000. 26000. 28000. 30000. 0. 0. 0.

44.50 1. *
44.52 2. B
44.54 3. B
44.56 4. B
44.58 5. B
44.60 6. BO
44.62 7. .B
44.63 8. .BO
44.65 9. . B
44.67 10. .B
44.69 11. .BO
44.71 12. .B.
44.73 13. .B
44.75 14. . *
44.77 15. . B
44.79 16. . B
44.81 17. . BO
44.83 18. . BO
44.85 19. . .BO
44.87 20. . .B
44.88 21. . . B
44.90 22. . . B
44.92 23. . . B.
44.94 24. . . .B
44.96 25. . . . B
44.98 26. . . . B
45.00 27. . . . B
45.02 28. . . . B
45.04 29. . . . OB
45.06 30. . . . B
45.08 31. . . . OB
45.10 32. . . . OB
45.12 33. . . . OB
45.13 34. . . . OB
45.15 35. . . . OB.
45.17 36. . . . OB
45.19 37. . . . .OB
45.21 38. . . . B
45.23 39. . . . OB
45.25 40. . . . B
45.27 41. . . . B
45.29 42. . . . B.
45.31 43. . . . B
45.33 44. . . . .BO
45.35 45. . . . .BO
45.37 46. . . . . B
45.38 47. . . . . BO
45.40 48. . . . . B
45.42 49. . . . . BO.
45.44 50. . . . . B
45.46 51. . . . . .B
45.48 52. . . . . B
45.50 53. . . . . B

OVN

DAM BREACH DATA

BRWIC	Z	ELBM	TFAIL	WSEL	FAILEL
100.	0.50	1397.00	1.00	1415.00	1424.00

WARNING *** TOP OF DAM, BOTTOM OF BREACH, OR LOW-LEVEL OUTLET IS NOT WITHIN RANGE OF GIVEN ELEVATIONS IN STORAGE-ELEVATION DATA
BOTTOM OF RESERVOIR ASSUMED TO BE AT 1390.60
STORAGE-ELEVATION DATA WILL BE EXTRAPOLATED ABOVE ELEVATION 1420.00

PEAK OUTFLOW IS 13480. AT TIME 46.00 HOURS

********** ********** ********** ********** **********

PEAK FLOW AND STORAGE (END OF PERIOD) SUMMARY FOR MULTIPLE PLAN-RATIO ECONOMIC COMPUTATIONS
FLOWS IN CUBIC FEET PER SECOND (CUBIC METERS PER SECOND)
AREA IN SQUARE MILES (SQUARE KILOMETERS)

OPERATION	STATION	AREA	PLAN	RATIOS APPLIED TO FLOWS RATIO 1 0.50
HYDROGRAPH AT	RES	30.10	1	13512.
		(77.96)		(382.62)(
			2	13512.
				(382.62)(
ROUTED TO	DAM	30.10	1	28841.
		(77.96)		(816.70)(
			2	13480.
				(381.70)(

SUMMARY OF DAM SAFETY ANALYSIS

PLAN 1 .....

	INITIAL VALUE	SPILLWAY CREST	AVERAGE TOP OF DAM
ELEVATION	1415.00	1415.00	1422.40
STORAGE	617.	617.	1305.
OUTFLOW	0.	0.	10124.

RATIO OF PMF	MAXIMUM RESERVOIR W.S.ELEV	MAXIMUM DEPTH OVER DAM	MAXIMUM STORAGE AC-FT	MAXIMUM OUTFLOW CFS	DURATION OVER TOP HOURS	TIME OF MAX OUTFLOW HOURS	TIME OF FAILURE HOURS
0.50	1422.93	0.53	1365.	28841.	1.33	45.50	44.50

PLAN 2 .....

	INITIAL VALUE	SPILLWAY CREST	TOP OF DAM
ELEVATION	1415.00	1415.00	1422.40
STORAGE	617.	617.	1305.
OUTFLOW	0.	0.	10124.

RATIO OF PMF	MAXIMUM RESERVOIR W.S.ELEV	AVERAGE ~~MAXIMUM~~ DEPTH OVER DAM	MAXIMUM STORAGE AC-FT	MAXIMUM OUTFLOW CFS	DURATION OVER TOP HOURS	TIME OF MAX OUTFLOW HOURS	TIME OF FAILURE HOURS
0.50	1423.14	0.74	1389.	13480.	6.75	46.00	0.0

APPENDIX E

REGIONAL GEOLOGY

H. B. NORTON DAM
NDI No. PA 00385, PennDER No. 24-35

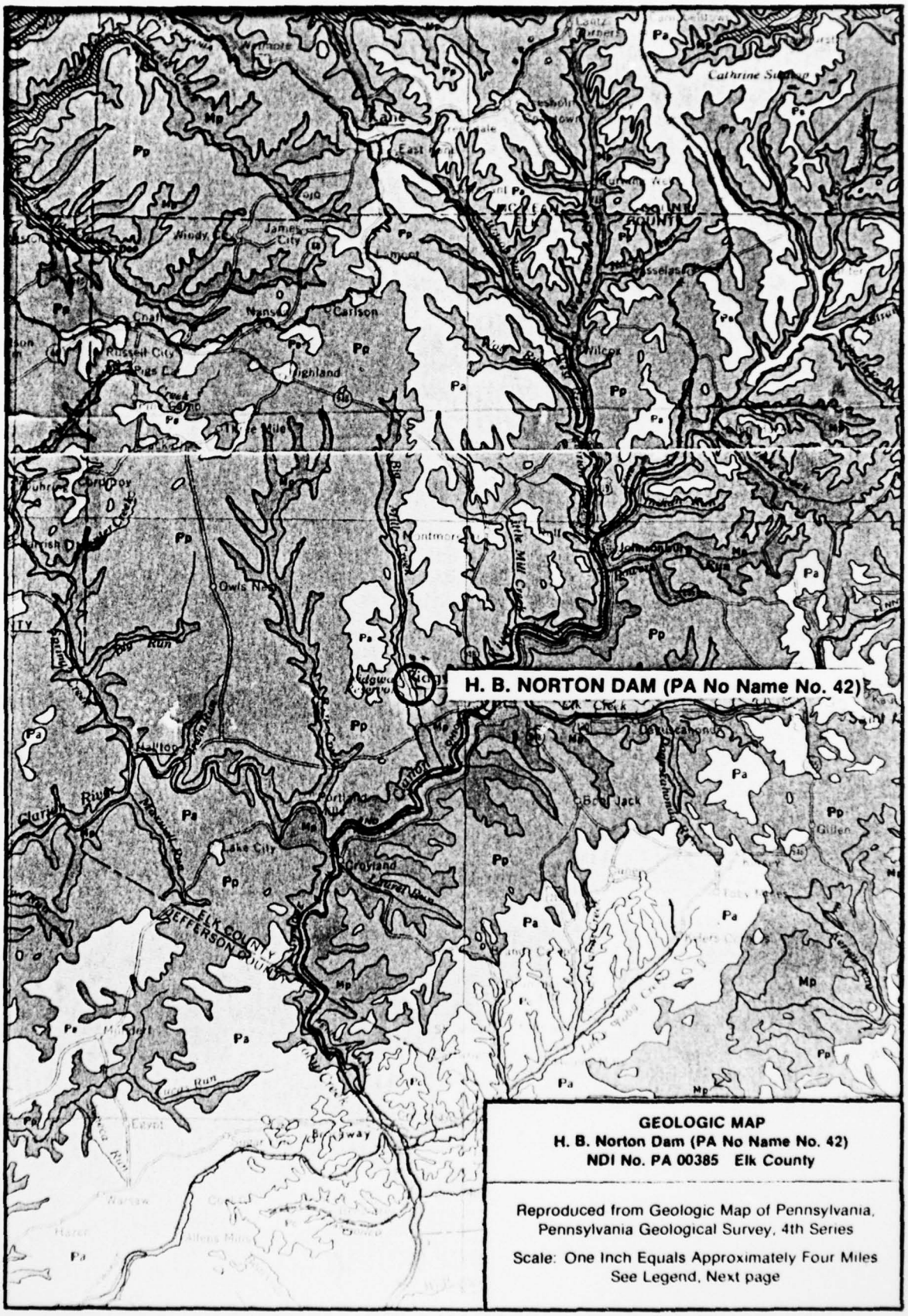
REGIONAL GEOLOGY

The H. B. Norton Dam is located in the northern unglaciated section of the Appalachian Plateaus physiographic province.

In the lower portion of the Big Mill Creek valley where the dam is located, bedrock units are members of the Pocono group, Mississippi system. Typically these units are gray, hard, and massive conglomerates and sandstones with some shale. Bedrock exposed in a pit during construction was described as "laminated sandstone."

Structurally, the bedrock dips gently to the northwest toward the axis of the Johnson Run Syncline, generally in the upstream direction. No reference is made in geologic literature of any major faulting in the dam area.

The "dense blue clay" and "hardpan," described in the foundation area by engineers during construction of the dam, are probably alluvial stream deposits and highly weathered bedrock, respectively. They were reportedly about 10 feet thick. According to reference materials, the sides of the valley are mantled with a relatively thin blanket of Allegheny-Dekalb residual soils.



GEOLOGIC MAP
H. B. Norton Dam (PA No Name No. 42)
NDI No. PA 00385 Elk County

Reproduced from Geologic Map of Pennsylvania, Pennsylvania Geological Survey, 4th Series

Scale: One Inch Equals Approximately Four Miles
See Legend, Next page

LEGEND

PERMIAN

Pg — **Greene Formation**
Cyclic sequences of sandstone, shale, red beds, limestone and coal; base at the top of the Upper Washington Limestone.

PERMIAN AND PENNSYLVANIAN

PPw — **Washington Formation**
Cyclic sequences of sandstone, shale, limestone and coal; some red shale; some mineable coal; base at the top of the Waynesburg Coal.

PENNSYLVANIAN

APPALACHIAN PLATEAU

Pm — **Monongahela Formation**
Cyclic sequences of sandstone, shale, limestone and coal; limestone prominent in northern outcrop areas; shale and sandstone increase southward; commercial coals present; base at the bottom of the Pittsburgh Coal.

Pc — **Conemaugh Formation**
Cyclic sequences of red and gray shales and siltstones with thin limestones and coals; massive Mahoning Sandstone commonly present at base; Ames Limestone present in middle of sections; Brush Creek Limestone in lower part of section.

Pa — **Allegheny Group**
Cyclic sequences of sandstone, shale, limestone and coal; numerous commercial coals; limestones thicken westward; Vanport Limestone in lower part of section; includes Freeport, Kittanning, and Clarion Formations.

Pp — **Pottsville Group**
Predominantly sandstones and conglomerates with thin shales and coals; some coals mineable locally.

ANTHRACITE REGION

Ppp — **Post-Pottsville Formations**
Brown or gray sandstones and shales with some conglomerate and numerous mineable coals.

Pp — **Pottsville Group**
Light gray to white, coarse grained sandstones and conglomerates with some mineable coal; includes Sharp Mountain, Schuylkill, and Tumbling Run Formations.

MISSISSIPPIAN

Mmc — **Mauch Chunk Formation**
Red shales with brown to greenish gray flaggy sandstones; includes Greenbrier Limestone in Fayette, Westmoreland, and Somerset counties; Loyalhanna Limestone at the base in southwestern Pennsylvania.

Mp — **Pocono Group**
Predominantly gray, hard, massive, cross-bedded conglomerate and sandstone with some shale; includes in the Appalachian Plateau Burgoon, Shenango, Cuyahoga, Cussewago, Corry, and Knapp Formations; includes part of "Oswayo" of M. L. Fuller in Potter and Tioga counties.

DEVONIAN

UPPER

WESTERN PENNSYLVANIA

Dos, Dr — **Oswayo Formation**
Greenish gray to gray shales, siltstones and sandstones becoming increasingly shaly westward; considered equivalent to type Oswayo. Riceville Formation Dr *in Erie and Crawford Counties; probably not distinguishable north of Corry.*

Dcr — **Cattaraugus Formation**
Red, gray and brown shale and sandstone with the proportion of red decreasing westward; includes Venango sands of drillers and Salamanca sandstone and conglomerate; some limestone in Crawford and Erie counties.

Dc — **Conneaut Group**
Alternating gray, brown, greenish and purplish shales and siltstones; includes "pink rock" of drillers and "Chemung" and "Girard" Formations of northwestern Pennsylvania.

Dcn — **Canadaway Formation**
Alternating brown shales and sandstones; includes "Portage" Formation of northwestern Pennsylvania.